Fisheries Resource Conservation Council

Strategic Conservation Framework for Atlantic Snow Crab

Report to the Minister of Fisheries and Oceans

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LETTER TO THE MINISTER

106-00972/

June 20, 2005

The Honourable Geoff Regan, P.C., M.P.
Minister of Fisheries and Oceans
200 Kent Street
Ottawa, ON K1A 0E6

Dear Minister Regan:

The Fisheries Resource Conservation Council (FRCC or Council) is pleased to present you with its report entitled "A Strategic Conservation Framework for Atlantic Snow Crab". This report is in response to your request to review the current approaches to snow crab conservation and to recommend a long-term conservation strategy.

The report is a result of 20 public consultations and a three-day workshop with experienced snow crab harvesters throughout Atlantic Canada and Québec. The Council also received and reviewed over thirty high quality briefs and engaged in extensive discussions with DFO biologists and fisheries managers.

Your request for this review has presented the FRCC with a significant and interesting challenge. The snow crab resource will experience natural fluctuations of its biomass with or without fishing activity. Environmental and biological factors, as well as fishing activities will impact on resource availability and therefore, on sustainability of the fishery. This report provides a comprehensive review of the Atlantic snow crab fishing industry and makes recommendations that address issues related to resource conservation that the Department and stakeholders are able to influence through their actions. In the view of the Council the recommendations put forward promote long-term sustainability in the snow crab fisheries. It is important to note that while the Council's mandate was to look at long-term strategic conservation initiatives, there are immediate short-term issues that must be addressed if the snow crab resource is to achieve long-term sustainability in a broad context.

The Council has noted significant divergence in the strategies and practices of the industry from one area to another. Therefore, many of the Council's recommendations would not have universal application or interest.

The Council has identified three key principles to guide the achievement of sustainability for the snow crab fisheries. These principles are central to the strategic framework and the recommendations in the report:

1. Fisheries management needs to ensure that there is sufficient knowledge to protect snow crab and manage the snow crab fisheries;
2. Fishing strategies and fishing practices should optimize the protection of the incoming snow crab recruitment to the spawning stock and to the fishery; and
3. There is a need to modernize the management of snow crab fisheries to standards of the 21st century.

As a first step towards ensuring that there is sufficient knowledge to protect snow crab and to manage snow crab fisheries, the Council recommends the creation of an Atlantic-wide snow crab Science Council that would focus on gaps and opportunities and improve the flow of information between regions. This measure would create a forum for discussion of such other recommendations as establishing objective based decision-making and structure the scientific and management advice based on biological units rather than management areas. The Council believes that a Science Council would be key to sharing overall knowledge and establishing common objectives and scientific data requirements.

Based on its analysis, the FRCC concludes that the recruitment to the spawning stock and to the fishery is insufficiently protected under current fishing strategies and practices. In order to better protect snow crab recruitment, the Council recommends that fishing seasons be adjusted to minimize the catch of soft-shell snow crab, that the monitoring of soft-shell protocols be improved, that handling mortality be reduced by ensuring proper training, awareness and regulatory structures for all participants, and that fishing capacity be better matched with the productive capacity of the snow crab resource.

The Council observes that all snow crab habitat is currently exploited and that there are no known refuges remaining. As a precautionary measure against socio-economic pressures for higher exploitation rates and imperfect knowledge of the factors driving snow crab recruitment and production, the Council recommends that protected areas be established. This measure would ensure that there are refuges where no human disturbance takes place and where snow crab as well as other marine species can prevail in their natural habitat. This recommendation is consistent with the long-term goals of Government and with the long-standing recommendations from previous FRCC reports to adequately protect the productivity of fisheries resources.

Although the present scale of the commercial harvest for snow crab is a relatively recent occurrence, traditional participants have experienced lows and highs of resource availability. Following the depletion of the resource in the Gulf of St. Lawrence in the late 1980s, industry and DFO cooperated to rebuild the stock. Industry presently expresses the view that the most significant uncertainty facing the snow crab fishery is the potential for short-term political decisions regarding the management of effort and the distribution of this effort to the resource. This brings us to our third principle, the modernization of the management of snow crab fisheries.

DFO needs to accelerate implementation of the Atlantic Fisheries Policy Framework to allow harvesters and their representative organizations a stronger influence on the future of the fisheries. Co-management is a key element in the strategy and shared-stewardship will result from co-management ensuring that industry is responsible for its actions. Harvesters have clearly stated that they want changes to the current management system and have expressed their willingness to participate in conservation and management decisions. The FRCC accepts these basic tenets and recommends reinforcing and strengthening the management structures to make them more workable than at present. The Council recommends the development of a framework for co-management that would include a dispute settlement mechanism.

The opportunity brought about by the expansion of the snow crab resource in Canada's Atlantic region has the potential for creating socio-economic pressures similar to those which lead to the demise of the groundfish resource. The FRCC believes that co-management and shared-stewardship are the best protection against such pressures. Co-management, however, cannot solve all problems, particularly those related to access and allocation. Therefore, the Council recommends that an independent third party structure be created to deal with access and allocation issues, based on pre-established procedures and guidelines.

This report is not prescriptive in the micro-sense as to the specific measures to achieve long-term sustainability. For example, the Council is not recommending specific numbers of traps or vessels to be used in the fishery. Rather, the report provides mechanisms and tools whereby stakeholders will have an enhanced role in the decisions required to ensure sustainable fisheries. It is necessary to move towards shared-stewardship of the resource where all parties need to demonstrate responsibility and accountability.

Finally, this report would not have been possible without the significant contributions by those who attended public meetings and/or provided written briefs; without the input, advice and analysis provided by the DFO biologists and managers; and, finally without the dedication of Council members and ex-officios.

The FRCC sincerely thanks them for their contributions and hopes their efforts are helpful to you and your Department.

Sincerely,

Jean Guy d'Entremont

Jean Guy d'Entremont,
Chairman

1 Introduction

1.1 Mandate and Approach

In November 2003, the Hon Robert Thibault then Minister of Fisheries and Oceans asked the Fisheries Resource Conservation Council ('FRCC' or 'Council') to develop a long-term conservation strategy for Atlantic Snow Crab modeled on the Atlantic Lobster Conservation Framework developed by the FRCC in 1995.

Subsequent to its work on Gulf of St. Lawrence groundfish in June 2004 the Council began the task of developing a long-term Strategic Conservation Framework for Atlantic Snow Crab. The Council began its review by meeting with several DFO biologists and fisheries managers throughout Atlantic Canada and Québec in order to acquire the much detailed background information and an historical perspective of the snow crab fishing industry. During September and October 2004, the Council held 17 public consultations with stakeholders across Atlantic Canada and Québec. Additional meetings were held with First Nations in three separate locations.

In December 2004, the Council held a three-day workshop that included experienced snow crab harvesters and processors throughout the industry and snow crab scientists and managers of the Department of Fisheries and Oceans (DFO). The purpose of the workshop was to ensure that the FRCC received practical input from principal interested parties throughout the regions on the issues, opportunities and options highlighted during public consultations.

The FRCC is confident that it has provided a strategic framework that will assist DFO and the Atlantic snow crab fishing industry in the development of harvesting plans that will achieve sustainable use of the snow crab resource.

1.2 Background and Context

The Minister requested the FRCC to provide a report modeled on the 1995 Strategic Conservation Framework for Lobster. The Council interpreted the Minister's request as a requirement to identify the main conservation issues and to provide options to improve the long-term sustainability of snow crab fisheries as opposed to a prescriptive proposal to manage snow crab fisheries for the whole of Atlantic Canada and Québec.

During the consultations, harvesters frequently expressed concerns with access and allocations issues. As these concerns were not within the Council's mandate, it was a challenge for the FRCC to focus discussions on the conservation issues facing the snow crab fishery. Nevertheless, the Council was able to extract from the consultations and briefs presented sufficient information to reach a broad understanding of the major conservation concerns facing the snow crab resource. During consultations it became evident that the Council would need to validate with stakeholders its understanding of the major problems before it could proceed with developing the framework. The workshop provided that validation and resulted in a better understanding, by the Council, of pertinent issues related to the long-term conservation of the resource. It also provided strategic direction on how to guide the future of Atlantic snow crab fisheries.

Although separate discussions took place with Native harvesters and their organizations, the Council concluded that the conservation issues were very similar for Native harvesters as they were for non-Natives. The contrasting feature between the discussions was that Native harvesters and First Nations expressed a clear objective of sharing the economic benefits from the fishery communally.

The FRCC believes that sustainable use of the snow crab resource can be achieved by the transfer of knowledge and best practices between and among different regions of the fishery. Threats to sustainability do exist due to the lack of knowledge of snow crab biology, the overcapacity that is apparent in the industry, and the cyclical nature of the resource that requires adjustments in management. Of most concern is the lack of appreciation of the effect of poor fishing practices in a number of areas. Traditional harvesters that have experienced the effect of poor fishing practices have a greater awareness of the measures necessary to conserve the resource; however, many harvesters have yet to understand and appreciate the disastrous effects poor fishing practices can have on sustainability.

Lack of enforcement was frequently raised at consultations as a threat to resource conservation. Although the Council acknowledges the impact that the absence of proper enforcement may have on the resource, this issue is not exclusive to snow crab. Enforcement is an issue in most fisheries and should be subject of a separate analysis. In the past, the FRCC has been a

proponent of a new regime supported with tools such as administrative sanctions to effectively deal with most enforcement related issues. Such a regime would likely help all sectors of the Canadian fishing industry, including the snow crab sector.

The strategic framework for snow crab focuses on the known issues affecting conservation and suggests vigilance with regard to the unknown. The Council undertook the development of the strategic framework knowing that a number of potential recommendations would be difficult to implement in the present management context given the existing political, legal and technical regimes. Many of the FRCC's recommendations in this report can be implemented immediately while others may take years. The effect the report may have on the fishery will depend on the timing of its implementation.

1.3 Definition of Sustainability

Although the concept of "sustainability" has been a tenet of fisheries management for at least fifty years, many fisheries have not achieved that status. Over the years the concept of sustainability has evolved from the conservation of single species to the conservation of both the ecosystem and the human system, with a balance between resource conservation and human concerns. In the context of sustainable utilization, the modern concept of sustainability is seen as having ecological, social, economic, and institutional aspects.

The ecological component of sustainability incorporates the conservation of single species, but also aims at conserving other species and includes the fundamental responsibility of conserving the resilience and structure of the ecosystem. The Council notes that from a fish population dynamics perspective, sustainability does not correspond to a unique combination of yield or fishing effort value. Typically, the biomass capable of producing the maximum sustainable yield is viewed as optimal, but fisheries are sustainable at higher and lower biomasses. The Council also notes that, due to natural variability and changes in the environment, some resources may be threatened biologically even in the absence of exploitation.

The social and economic components of sustainability focus on the creation of sustainable benefits, their reasonable distribution, and the maintenance of sustainable enterprises within local and global economies. In this context, a sustainable fishery policy is concerned about human systems because the sustainability of communi-

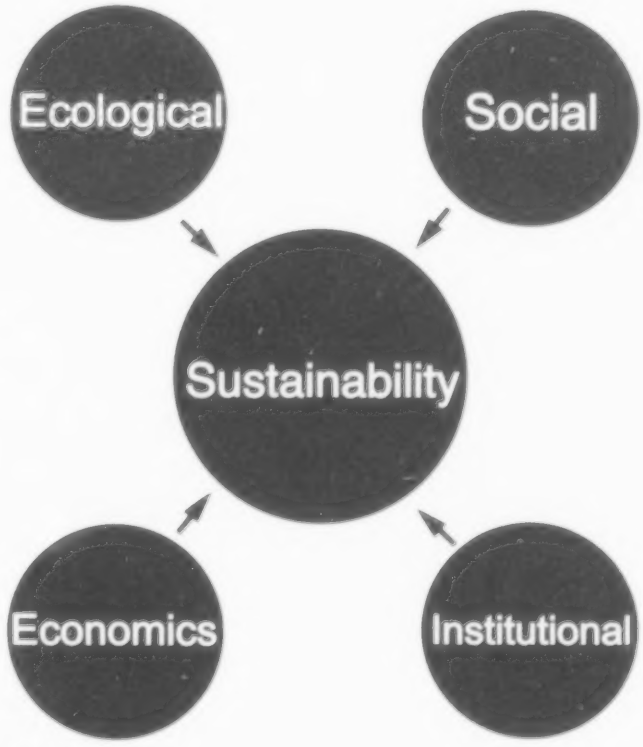


Figure 1: Definition of sustainability

ties is closely linked to the sustainability of fisheries and vice versa. The FRCC believes that fishery management should focus on conserving fishery resources to achieve long-term sustainable fisheries that provide jobs, economic opportunities and food. Achieving these goals should increase the stability of communities.

The institutional, or governance, component of sustainability involves the provision of suitable financial, administrative and organizational capability over the long-term. It refers to the set of rules that are used and the bodies that have the responsibility to implement them (government, community, or otherwise). Institutional sustainability helps ensure that the rules that are adopted are practical, that it is possible to implement them, and that monitoring, control and surveillance is adequate.

The modern concept of sustainability requires that a reasonable balance should be struck between the four components. Systems that give disproportionate importance to one or another component will have lower chances of reaching overall sustainability. Without a balance, the pendulum will swing from over-fishing to protection where all the importance is given to resource conservation at the detriment of other components. "Reasonable balance" will vary according to biological productivity of the ecosystem, social preferences and societal values. Implementing the modern concept of sustainability requires the involvement, accountability, and commitment of diverse parties.

The Council's mandate is mostly concerned with the bio–ecological component of sustainability, but the major threats to snow crab conservation in Atlantic Canada have strong social, economic and institutional components. In this report, the Council will therefore consider all aspects of sustainability with regards to the snow crab fisheries.

1.4 Sustainability of Snow Crab

The snow crab fisheries, as they have developed on Canada's Atlantic coast, present considerably less conservation risks than fisheries for groundfish and pelagic species. Nonetheless, there remains a risk of stock collapses due to unsustainable fishing as highlighted by the collapse of the Bering Sea snow crab fishery, which was partly caused by over-fishing. Furthermore, fishing could exacerbate the natural fluctuations of snow crab, particularly when poor fishing strategies are practiced and the fishery is not managed properly from a conservation perspective.

The snow crab fishery along Atlantic Canada's coast has several strengths that minimize the risks to conservation. These include:

- females are not targeted by the fishery because they reach their terminal moult, that is they stop growing, at a size smaller than the minimum landing size of 95mm carapace width;
- the exploitation rate on mature male snow crab above 95mm carapace width is less than 100% leaving some mature males to mate with available females;
- some males become mature and reach their terminal moult at sizes less than 95mm carapace width, therefore these male crabs are protected from the fishery and can also mate with the females; and
- females can store sperm for several years after mating and can selectively choose the sperm to use to fertilize their eggs.

It is important to note that all these strengths applied in the Alaskan snow crab fishery and did not prevent it from collapsing. However, in the Alaskan fishery there remain uncertainties regarding male terminal moult and disease related mortality. So in spite of the apparent strengths, conservationis not guaranteed due in part to lack of knowledge and the misleading perception that the strengths of the fishery, as noted above, are sufficient to ensure sustainability. Lack of knowledge is one of the key issues posing a threat to snow crab conservation in Canada's Atlantic region. Some of the knowledge gaps are as follows:

- in heavily fished areas the effect of high exploitation is such that, the depletion of mature male snow crab may result in too few commercial size mature males being available to mate with all the available females;
- high exploitation rates distributed over the entire population result in a high proportion of soft-shell crab in the catch. These soft-shelled crabs are discarded in the fishery, and the large majority die, jeopardizing recruitment;
- if the size of terminal moult to maturity is density dependent, high exploitation rates may cause small male snow crab to become mature early in their life cycle and reach their terminal moult below 95mm carapace width;
- the entire range of the snow crab population is now being exploited leaving no reserve populations to buffer against over-fishing;

- selectively harvesting a high proportion of large mature males may result in genetic change, shifting the size composition of the population to smaller sizes below the present commercial size;
- differential fluctuations in the abundance of males and females may result in the number of males being insufficient to mate with all or many of the females when females are at their peak abundance and male abundance is low; and
- insufficient understanding of stock structure may lead to poor or conflicting management decisions where high exploitation in one area may have detrimental effects in another area.

1.5 The Precautionary Approach

Management decisions must be made in an environment of considerable uncertainties regarding the factors affecting the productivity of snow crab resources and the effects of fishing. The Precautionary Approach (PA) provides guidelines on how to operate in such a context. The PA involves prudent foresight to:

- avoid irreversible damage in order to protect the needs of future generations;
- enable prior identification of situations to be avoided and the measures available to promptly correct the situation;
- effect quick implementation of corrective measures;
- give priority to protecting the productive capacity of the resource;
- match the harvesting and processing capacity with the productivity of the resource; and
- review periodically the type and amount of fishing activity that is allowed.

The identification of targets and thresholds in terms of exploitation rates and biomass are normally used in a precautionary approach framework to identify safe zones in which the stock is considered within safe biological limits; buffer zones where management action is required to remedy unsatisfactory conditions; and danger zones where stocks are considered outside safe biological limits.

The FRCC concludes that the cautious approach adopted in some snow crab fishing areas, the generally good rapport between the fishing industry and DFO scientists, and the decision to harvest only mature male snow crab have provided the basic ingredients for sound fishery management. Nonetheless, improvements are necessary to increase the knowledge base for fishery management and to reduce the effects of poor fishing strategies and practices.

1.6 Principles

The Council has identified three key principles to guide the achievement of sustainability for the snow crab fisheries. These principles are central to the strategic framework and the recommendations in the report:

1. Fisheries management needs to ensure that there is sufficient knowledge to protect snow crab and manage the snow crab fisheries;
2. Fishing strategies and fishing practices should optimize the protection of the incoming snow crab recruitment to the spawning stock and to the fishery; and
3. There is a need to modernize the management of snow crab fisheries to standards of the 21st century.

Snow crab traps on fishing boat
Snow Crab Section, Oceans and Science Branch, DFO, Gulf Region, Moncton, N.B.

2 History and Biology of Snow Crab

2.1 Historical Development of the Fishery

Snow crab off Canada's Atlantic coast was not fished commercially until the 1960s. An opportunity created by a decline in market supply internationally prompted industry and government to develop the fishery. Up to that time snow crab was considered a nuisance particularly, when they fouled gillnets used to harvest groundfish.

Since that time the fishery has expanded even though a period of decline occurred in the 1980s. Today the snow crab industry throughout the Atlantic Provinces and Québec is second only to lobster in terms of value.

2.1.1 The early years 1960s - 1970s

Prior to the development of the snow crab fishery, groundfish trawlers in the Gulf of St. Lawrence landed some by-catch of snow crab. In 1966, following an exploratory trip that indicated commercial quantities in the Gulf, the first directed fishery was initiated by governments and industry in Nova Scotia, New Brunswick and PEI. The product was first marketed as Queen Crab, however, due to labelling requirements in the United States, the name was changed to Snow Crab. Commercial fishing increased from 1966 and spread throughout the Atlantic Provinces and Québec, as DFO and provincial governments promoted development and expansion. By 1968, the fishing fleet in the Gulf of St. Lawrence had grown to some 60 vessels that took part in the snow crab fishery for at least part of the season. In New Brunswick several plants were processing snow crab by 1969 and more capacity was being added throughout the Atlantic region.

A government-industry conference in 1969 noted the expansion with both optimism and concern. A.W.H. Needler, federal Deputy Minister of Fisheries, said that "we don't know the size of the resource, we don't feel that we have developed the best methods of catching crabs, of processing them for quality control, and we don't know what government regulations might be needed to preserve the stock and maintain quality." Despite progress in research, harvesting and management, some of these questions linger.

Early in the development of the fishery, DFO banned the use of trawls to harvest snow crab and limited the number of traps fished per vessel. A minimum size limit was introduced at 95mm carapace width making it illegal to land smaller sized snow crab. In addition, regulations set the trap-mesh size large enough to allow female snow crabs to escape. Excluding the females from the harvest became a fundamental principle of snow crab management throughout Atlantic Canada and Québec. Other harvesting rules introduced over time for various crab-fishing areas included restrictions on the harvesting of soft-shelled (moulting) snow crab, restraints on fishing periods, and the establishment of area-based Total Allowable Catch (TAC). Vessel trip limits or weekly harvest limits were also used to varying degrees.

Through the 1970s the snow crab industry continued to grow. The Gulf fishing fleet was based mainly in northern New Brunswick and the Gaspé region of Québec. This fleet comprised medium-size "mid-shore" vessels and it increased to about 130 vessels - about 80 from New Brunswick, nearly 50 from Québec, and 2 from Nova Scotia. By 1982, snow crab landings reached 20,300 tonnes in New Brunswick and 11,600 tonnes in Québec.

The Québec fishery expanded along the north shore of the Gulf of St. Lawrence where smaller vessels took part in the fishery. Smaller, less specialized vessels also began the fishery off western Cape Breton, particularly the Cheticamp area. In 1978, DFO established a separate snow crab fishing area for the fleet in this area, with a 45-foot limit on participating vessels.

During the late 1970s, snow crab fisheries began off eastern Nova Scotia. In 1982, the area's landings totalled 2,200 tonnes, while Prince Edward Island's small fishery harvested only 600 tonnes. During 1982, the combined snow crab landings of the Maritimes and Québec reached nearly 35,000 tonnes, with a landed value of $31.7 million.

The snow crab fishery commenced in Newfoundland in 1968, shortly after the start in the Gulf of St. Lawrence. The fishery grew throughout the 1970s and by the early 1980s snow crab fishing had expanded to areas along the coast of the island and as far north as the coastal waters of Labrador. Improving market conditions mainly drove the expansion of the snow crab fishery. By 1982, Newfoundland had a significant mobile fleet, comprised of about 70 vessels, ranging between 45 and 65 feet in length. In 1982, snow crab landings totalled

13,500 tonnes in Newfoundland, second only to the fishery in New Brunswick.

New snow crab management areas were created as the fishery expanded and the area boundaries were established more on the basis of controlling the effort of the fleets than matching the fishery to the biological characteristics of the resource.

2.1.2 Downturn – 1980s

Catches began to drop throughout the Atlantic region during the mid to late 1980's. Total Atlantic landings fell sharply from 48,300 tonnes in 1982 to only 22,400 tonnes in 1989, causing widespread concern. The causes of the decline remain uncertain, however, industry participants indicate that poor fishing practices during this period contributed to the decline. Harvesters note that the industry was generally undisciplined at the time with 'a race for fish' and a high incidence of soft-shelled snow crab harvested during the fishery.

In the years following the decline, harvesters and DFO in some areas affected focused increasing effort on snow crab research, management, and enforcement in the snow crab fishery. Harvester's organizations took a stronger interest in resource conservation. Fishing practices and compliance with regulations improved and individual boat quotas began to be introduced throughout the snow crab fishery. Some fleets, most notably in the Gulf of St. Lawrence, concluded joint agreements or other co-management arrangements with DFO. Generally, these initiatives improved the management of the fishery and provided the opportunity for harvesters to be directly involved in conserving the resource.

2.1.3 The 1990s upsurge

By 1991-92, snow crab landings throughout the region had recovered to compare with the early 1980s. A period of unprecedented growth began. Expansion of the fishery continued due to biomass increases and the expansion of fishing effort, including the exploitation of new fishing grounds. Snow crab landings almost tripled, from 36,500 tonnes in 1992 to 106,000 in 2002 (see Figure 2- snow crab landings for Atlantic Canada and Québec). Notable increases during the 1990s occurred off eastern Nova Scotia and in the offshore areas off Newfoundland. Indeed, Newfoundland took a strong lead in landings over the period with landings peaking at 69,000 tonnes in 1999. The total value of all snow crab landings surged from $61.4 million in 1992 to $623.3 million in 2004, making the snow crab fishery second only to lobster in terms of value.

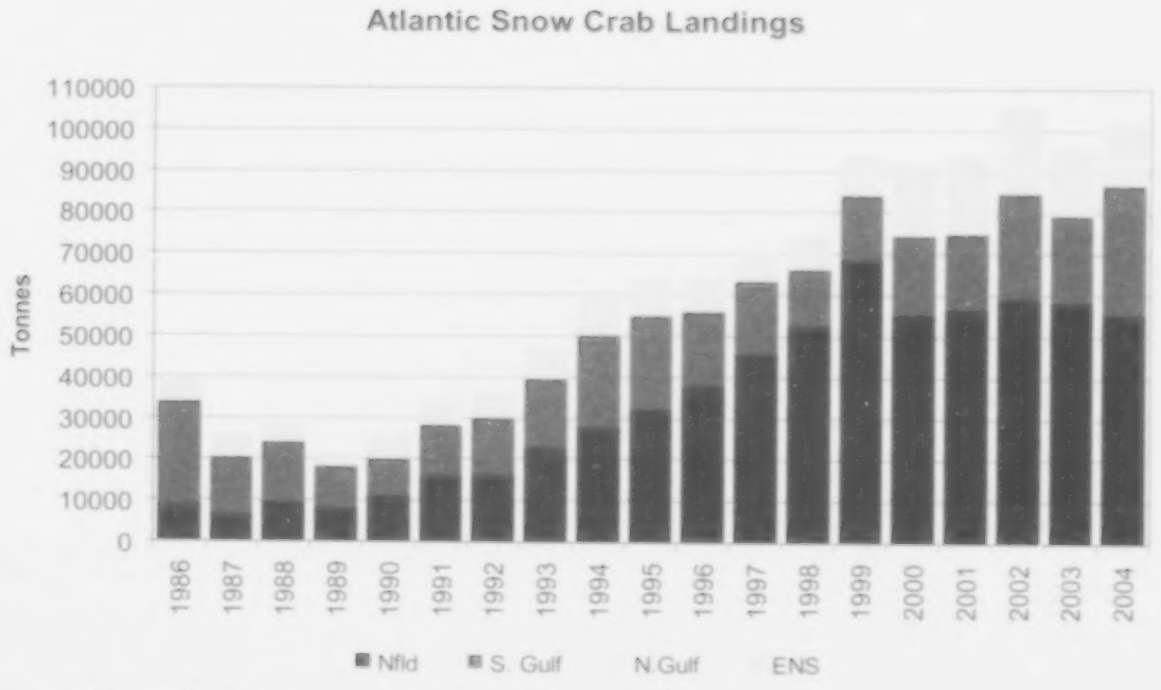


Figure 2: Historical Landings

2.1.4 Fishing effort outpaces the resource

Greater fishing effort during the 1990s increased landings, with more participants fishing all habitat throughout the Atlantic region. In some instances, larger areas were subdivided into smaller ones, not all of which could sustain the increased fishing effort. Pressure for licences kept growing and more fishing effort was deployed. The total number of licences in the Maritimes and Quebec rose from about 500 in 1992 to over 1,000 in 2004. Although the newer licences authorized fewer traps per vessel, the snow crab resource now faced a far greater threat from the fishery.

The largest increase in licences occurred in Newfoundland. During the early 1980s the number of licences was about 70, the original "full-time" crab fleet. As inshore groundfish catches began shrinking in the 1980s, the Minister of Fisheries and Oceans (the Minister) allowed "supplementary" licences for vessels 35 to 65 feet, with lower numbers of traps per licence. This brought the total number of Newfoundland licences to more than 600 by 1988. Then, following the groundfish collapse of the early-1990's, the Minister in 1995 authorized some 400 additional "seasonal temporary permits" for vessels less than 35 feet in length.

The most significant increase in fishing effort was yet to occur. From 1996 on, the Minister allowed similar permits for all "core" harvesters with vessels less than 35 feet in overall length. This change dramatically increased the number of snow crab licences in Newfoundland and Labrador to more than 3,400.

Number of Snow Crab Licences		
Region	1992	2004
Maritimes and Québec	507	1072
Newfoundland and Labrador	750	3411

Over the following years, many tens of thousands of additional traps went into the water and fishing effort increased substantially. Meanwhile, the fishery in the 1980s and 1990s spread from its original concentration on the east coast to areas around Newfoundland, off the coast of Labrador, and in offshore waters, even outside the 200-mile limit. The entrance of thousands of new licences in the coastal areas pushed the larger inshore vessels to concentrate fishing effort on grounds further offshore. The movement of the larger vessels to the offshore areas was promoted by DFO through the incentive of increased individual quotas. Beyond the increase in the number of harvesters, there was also a huge investment in vessels, gear, and technology.

Atlantic-wide, new investment in processing plants, vessels and traps in the 1990s reached hundreds of millions of dollars. More than 60 plants were now operating, producing mainly frozen sections rather than extracting meat to satisfy international market demand. Dependence on snow crab, especially in Newfoundland, reached far greater heights. By the late 1990s early 2000s, several snow crab stocks were showing signs of decline and concerns about major downturns continue to prevail in a number of areas. Snow crab off Canada's Atlantic coast no longer had any refuge from fishing.

Outside of Canada, one of the most significant snow crab fisheries takes place in the Bering Sea where the fishery began in 1977. Landings were around 20-25,000 tonnes during the early 1980s but increased steeply to 150,000 tonnes annually by 1991. Following the heights of the fishery, landings declined sharply to about 25,000 tonnes by 1996 and subsequently rebounded in 1998. Since then the Alaskan snow crab fishery has plummeted to about 12,000 tonnes and has not recovered (Figure 3). Many explanations have been presented for the cycles and collapse of Bering Sea snow crab. Overfishing, poor recruitment, and shifting environmental conditions are all suspected to have played a role in the recent collapse and poor recovery.

Figure 3 - Alaskan Snow Crab Fishery Landings

2.2 Snow Crab Harvesting Activity

Snow crab harvesting activity is conducted almost exclusively by the inshore fleet (vessels less than 65 feet). The annual snow crab harvest is managed on the basis of TAC's established each spring for about 40 designated snow crab fishing areas (see Figure 4). Many of the snow crab fishing areas were created to control fishing effort and have little to do with the biological characteristics of the resource. The area TAC's are allocated to a carrying number of fishing enterprises that are licensed to harvest snow crab (Appendix I outlines a profile of the fishing activity in each Atlantic crab fishing zone). Each licenced fishing enterprise is allocated a specific tonnage of snow crab to be harvested. The individual allocation generally depends on the size of vessel operated, its history of participation in the fishery, and the number of licences participating in the fishing area.

Harvesting commences in the early spring depending on the area and fishing season. Fishing can continue through to late summer and early fall. Snow crab fishing is conducted with single conical shaped traps (pots) although some harvesters use rectangular shaped traps. Traps are attached to a vertical rope and marker buoy. In some areas, harvesters deploy several traps, strung in series to a main fishing line (known as a trawl) or fleet of gear. Twine mesh is used to enclose the traps that have an open cone at the top to provide an entrance for the snow crab. Each trap is baited to attract the snow crab into the trap. Once commercial size snow crabs enter the trap they are unable to escape. The twine mesh in the traps is regulated to a minimum size of 5 ¼ inches to select male snow crab greater than or equal to 95mm carapace width. Smaller than regulation size male snow crab and female snow crab do routinely enter the traps but are able to escape through the twine mesh. However, these non-targeted snow crabs are often retained in the traps and discarded following the retrieval of the catch during harvesting.

Snow crab harvesters are licenced to deploy a specific maximum number of traps to harvest their allocations. These trap limits vary by area and by the size and nature of the fishing enterprise. Snow crab fishing seasons are generally of short duration. Vessels operating

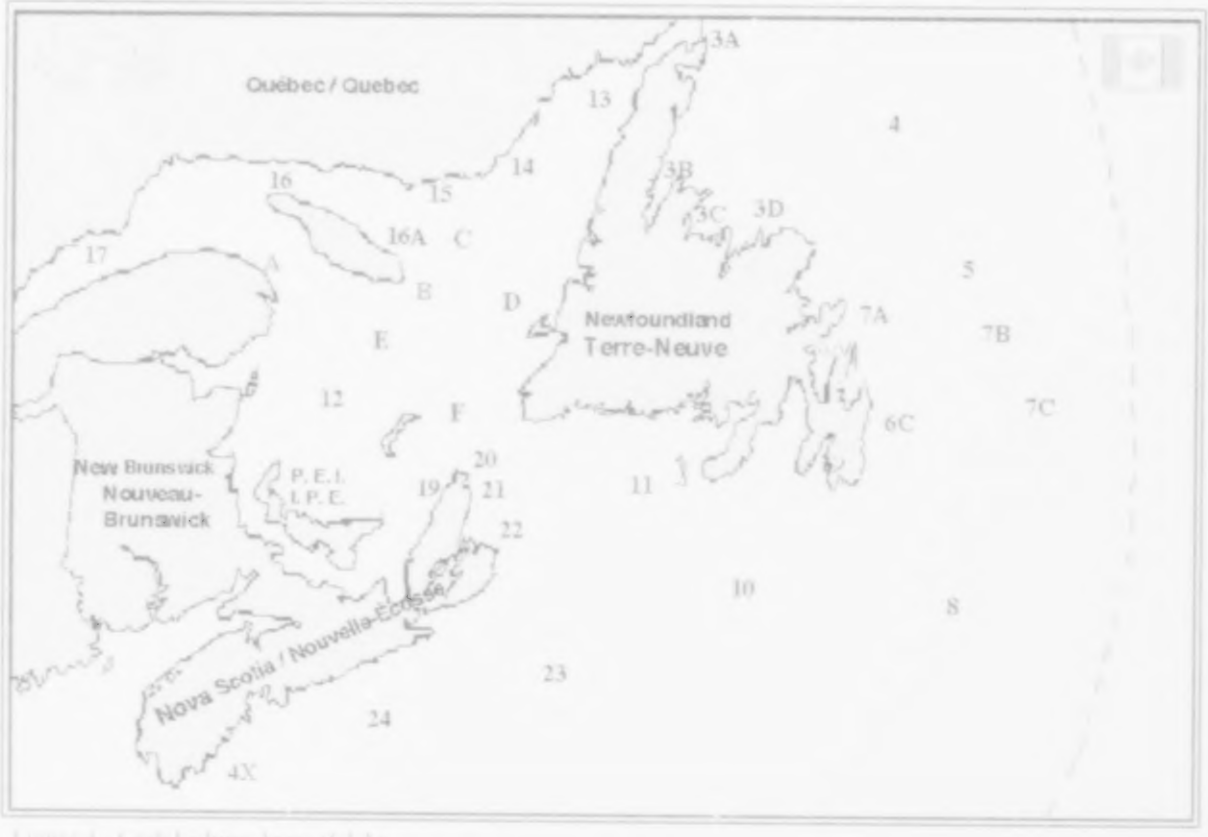


Figure 4 – Crab Fishing Areas (CFAs)

2.2 Snow Crab Harvesting Activity

Snow crab harvesting activity is conducted almost exclusively by the inshore fleet (vessels less than 65 feet). The annual snow crab harvest is managed on the basis of TACs established each spring for about 40 designated snow crab fishing areas (see Figure 4). Many of the snow crab fishing areas were created to control fishing effort and have little to do with the biological characteristics of the resource. The area TACs are allocated to a varying number of fishing enterprises that are licenced to harvest snow crab (Appendix I outlines a profile of the fishing activity in each Atlantic crab fishing zone). Each licenced fishing enterprise is allocated a specific tonnage of snow crab to be harvested. The individual allocation generally depends on the size of vessel operated, its history of participation in the fishery, and the number of licences participating in the fishing area.

Harvesting commences in the early spring depending on the area and fishing season. Fishing can continue through to late summer and early fall. Snow crab fishing is conducted with single conical shaped traps (pots) although some harvesters use rectangular shaped traps. Traps are attached to a retrieval rope and marker buoy. In some areas, harvesters deploy several traps attached in series to a main fishing line otherwise known as a fleet of gear. Twine mesh is used to enclose the traps that have an open cone at the top to provide an entrance for the snow crab. Each trap is baited to attract the snow crab into the trap. Once commercial size snow crabs enter the trap they are unable to escape. The twine mesh in the traps is regulated to a minimum size of 5 ¼ inches to select male snow crab greater than or equal to 95mm carapace width. Smaller than regulation size male snow crab and female snow crab do routinely enter the traps but are able to escape through the twine mesh. However, these non-targeted snow crabs are often retained in the traps and discarded following the retrieval of the catch during harvesting.

Snow crab harvesters are licenced to deploy a specific maximum number of traps to harvest their allocations. These trap limits vary by area and by the size and nature of the fishing enterprise. Snow crab fishing voyages are generally of short duration. Vessels operating

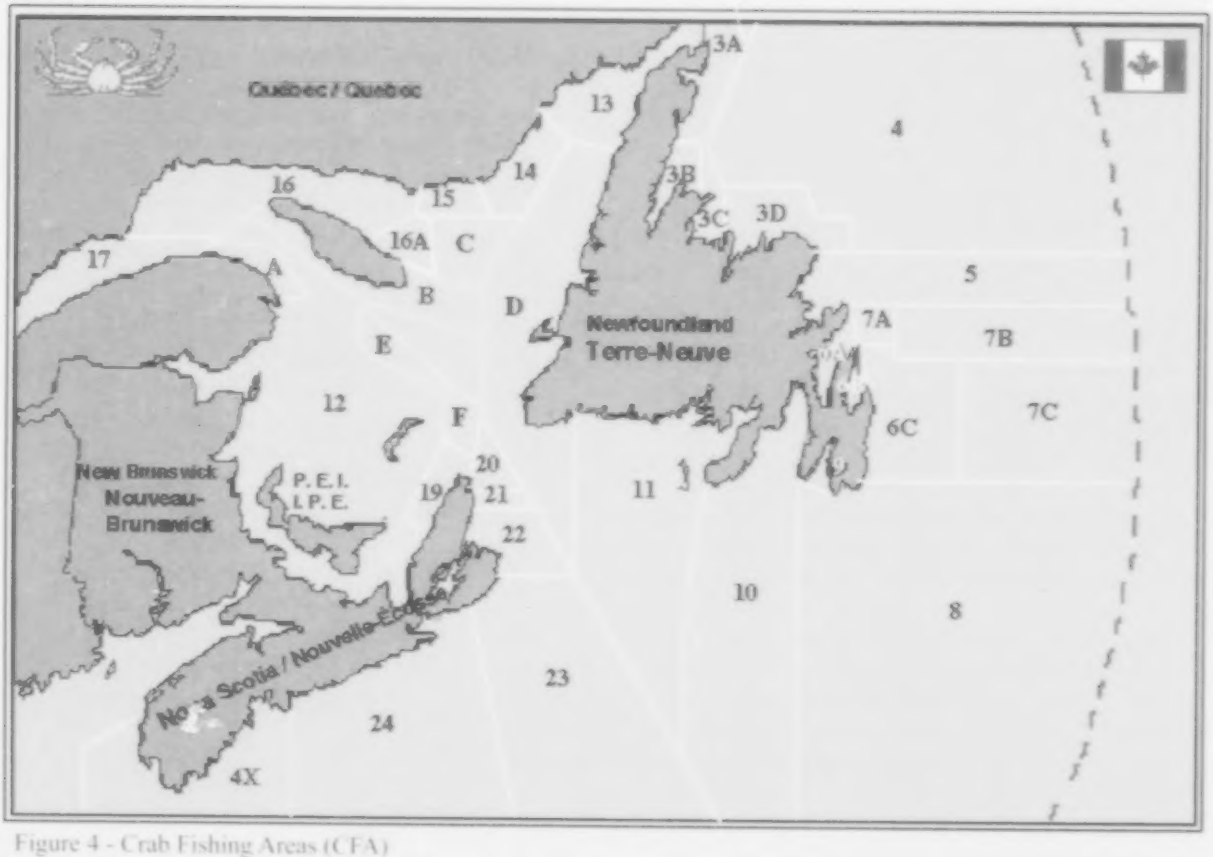


Figure 4 - Crab Fishing Areas (CFA)

in the bays and coastal regions return to port daily and generally leave their traps to fish for longer periods of time. Vessels fishing up to and beyond 200 miles from the coast conduct voyages up to four and five days and greater depending on the vessel's holding system. Typically these vessels leave the traps for shorter periods, sometimes only a few hours, prior to retrieving the catch. Given that snow crab must be live at the time of landing and processing, the duration of fishing trips is limited, although some vessels are now able to keep crab live on board in tanks permitting them to extend the length of their trips. Upon landing the live catch, it is weighted at dockside and transferred to shore-based processing facilities where the catch is processed into market ready products on a timely basis. All snow crab catches are independently monitored at dockside for quota management purposes.

2.3 Snow Crab Biology

Snow crabs (*Chionoecetes opilio*) are widely distributed along Canada's Atlantic coast but are found elsewhere in the world, most notably in the North Pacific Ocean including the Bering Sea, the Arctic Ocean and the Sea of Japan. In the Northwest Atlantic, they are found from southern Greenland to the Gulf of Maine. Snow crab is typically found on sandy or muddy bottoms and in temperatures ranging between -1°C to 5°C. They are generally found in relatively deep water but can also be found in water as shallow as 20m. Little is known about the stock structure of snow crab, with most of the information on distribution having been obtained from the fishery. The stock structure of snow crab is believed to be more complex than for most groundfish and pelagic fishes.

Snow crabs are crustaceans like lobster and shrimp, with a flat almost circular shaped body and five pairs of spider-like legs. Periodically, the hard outer shell is shed and the snow crab grows in a process called moulting. Adult males grow to sizes ranging between 60-165mm carapace widths. Females are smaller, only reaching 40-95mm width at maturity. Snow crab mating is complex. Males and females each go through three sexual stages of development: immature, adolescent, and mature with fully functional reproductive organs. Females that have mated for the first time after terminal moult, and are carrying eggs, are called primiparous or first time spawners while those that have mated more than once are called multiparous or repeat spawners. Most females reach terminal moult sometime between December and April. Most adolescent males reach terminal moult and maturity in the early spring but a small percentage does moult during the winter. First time mating generally takes place from February to mid-March, following the terminal moult. Mating by repeat spawners occurs later in the spring, sometime between April and June. It is believed that first-time spawners (primiparous) are less productive than the repeat (multiparous) spawners.

The eggs produced by the females can be carried in the abdomen for up to two years depending on the temperature. While both females and males have their abdomen folded under the body that of the females is much larger and is used to carry and protect eggs. Females produce broods of tens of thousands of larvae that are released from April to June and are carried by currents. Larval development may last from two to eight months depending on temperature and planktonic food supply. At a carapace width of about 3mm, the snow crabs settle to the ocean floor where they become immature crabs that then moult into juveniles, adolescents, and finally adult snow crabs. Once on the bottom, snow crabs go through a series of moults, with growth of roughly 20% between moults. It takes 5-10 years for male snow crab to reach legal size (95mm carapace width). The full natural life cycle for snow crabs is about 15 years.

Unlike lobsters, male and female snow crabs do not continue to moult throughout their lives. Females stop growing after the moult in which the abdomen widens substantially for carrying eggs. This typically occurs at carapace widths much less than 95mm. Males stop growing after the moult in which the claws enlarge appreciably for mating. This final terminal moult depends upon environmental and genetic conditions. Following moulting juvenile snow crab experience a period during which their new shell has not hardened. During this period, snow crab appears whitish and individuals are weak and vulnerable to handling mortality. During this developmental stage, snow crab is known as white crab or soft-shelled crab. Soft-shelled snow crabs have to be handled very carefully to avoid mortality and are likely much more susceptible to predatory mortality. The time from moult to completely hard-shelled crab may be several months during which period the snow crabs have very little meat in the shells and are of little commercial value.

Snow crab diet includes fish, clams, worms, brittle stars, shrimp, snow crab and other crustaceans. Predators include groundfish, other snow crabs and seals. As the fishery is sex selective, only removing males, it is not surprising that the populations number more females. The males and females do not always occur in the same geographic location at the same time nor are

all life stages evenly distributed spatially. In extreme cases it is possible that there are too few males to mate with all the females that could limit the reproductive potential. It should be noted that natural, unexploited, populations also exhibit cycles of sex ratio due to unknown reasons.

Snow crabs are susceptible to infections of parasitic dinoflagellates that live in the blood of snow crab. The disease can kill the crab and also causes the crab meat to have a bitter flavour, hence the name of the disease (bitter crab disease). Infected crabs can be identified from their opaque white shell and generally poor condition. The disease has been detected, to varying degrees, throughout the Atlantic region. In the Bering Sea, it has been suggested that bitter crab disease was an important factor in the collapse and poor recovery of the snow crab resource.

3 Acquiring the Knowledge to Protect Snow Crab

3.1 Introduction

One of the key considerations to achieve long-term sustainability is to ensure that there is sufficient knowledge to manage the snow crab fisheries and protect the resource. To accomplish this goal DFO and the industry should focus on improving knowledge on:

- The stock structure of snow crab throughout the Atlantic region;
- The exploitation rates and biomass for snow crab to establish targets and limits; and
- The assessment tools and processes for the collection, integration, analysis and interpretation of scientific data necessary to achieve management objectives.

These improvements in knowledge are the central topics of discussion in this chapter of the Council's report.

3.2 Snow Crab Stock Structure

Most fisheries, particularly fisheries for groundfish and pelagic species are managed on the basis of stocks that are defined to correspond closely to self-sustaining biological units. (A biological unit, by definition, is a population that is self-sustainable.) Therefore, if management is appropriate, it is possible to protect the productive capacity of the resource. For example, the cod stock in the southern Gulf of St. Lawrence (NAFO division 4T) and the cod present in Sydney Bight (NAFO subdivision 4Vn) during November to April are considered to belong to the same biological unit.

The stock structure for snow crab on Canada's Atlantic coast has not yet been conclusively defined. Limited tagging experiments have shown that snow crab moves little during their growth stages, once they have settled on the bottom. The little data available indicates migrations of about tens of kilometres per year. The snow crab management areas currently used do not all correspond to self-sustaining biological units that produce their own eggs, larvae, recruits and spawners. Snow crab has a more complex stock structure, one that likely conforms to the source-sink structure explained below than to the unit stock concept of traditional groundfish and pelagic fisheries.

Under the source-sink model, sources produce eggs and larvae that are carried by ocean currents while sinks receive their recruits from other areas, contributing little recruitment to their own area or to other areas. Depending on water currents and their variability, some areas may be both sources and sinks, either all the time or some of the time. Given the complex drift patterns of snow crab larvae, there are some areas that are both sources and sinks for snow crab production around the Atlantic region. While educated guesses can be made to distinguish sources and sinks, the current information and understanding are insufficient to draw firm conclusions.

Many of the current snow crab area lines do not delimit distinct biological units. Indeed, area lines go through the middle of large snow crab concentrations such as between areas 12 and 19. The existing lines are for management purposes and are not representative of biological units. In some instances the lines have been removed for management purposes (e.g. areas 25, 26 and 18) whereas in other cases lines have been added (e.g. 12A, 12B, 12C, 12E, 12F, 16A). Figure 5 shows several years of biomass estimates from the trawl survey in the southern Gulf of St. Lawrence with the management lines overlaid for illustration. The figure shows how management lines go through biological concentrations of snow crab and how the patterns of abundance change from year to year. Similar problems are believed to exist for other snow crab management areas in the Atlantic region.

The productive capacity of the snow crab resource varies geographically and over time as the ecosystem changes: some areas have consistently been highly productive; some have generally been productive but have experienced periods with little or no production; other areas have only been sporadically productive when seeded from another area in periods of high abundance or under favourable oceanographic conditions. While the fishing effort could be expected to remain reasonably stable in highly productive areas, it may need to be periodically curtailed in less productive areas, and perhaps fishing should occur only sporadically in marginal areas. Even in highly productive areas, snow crab is acknowledged to be a naturally cyclical resource with periods of high and low production due either to endogenous or environmental factors. Fishing could accentuate the cycles of snow crab.

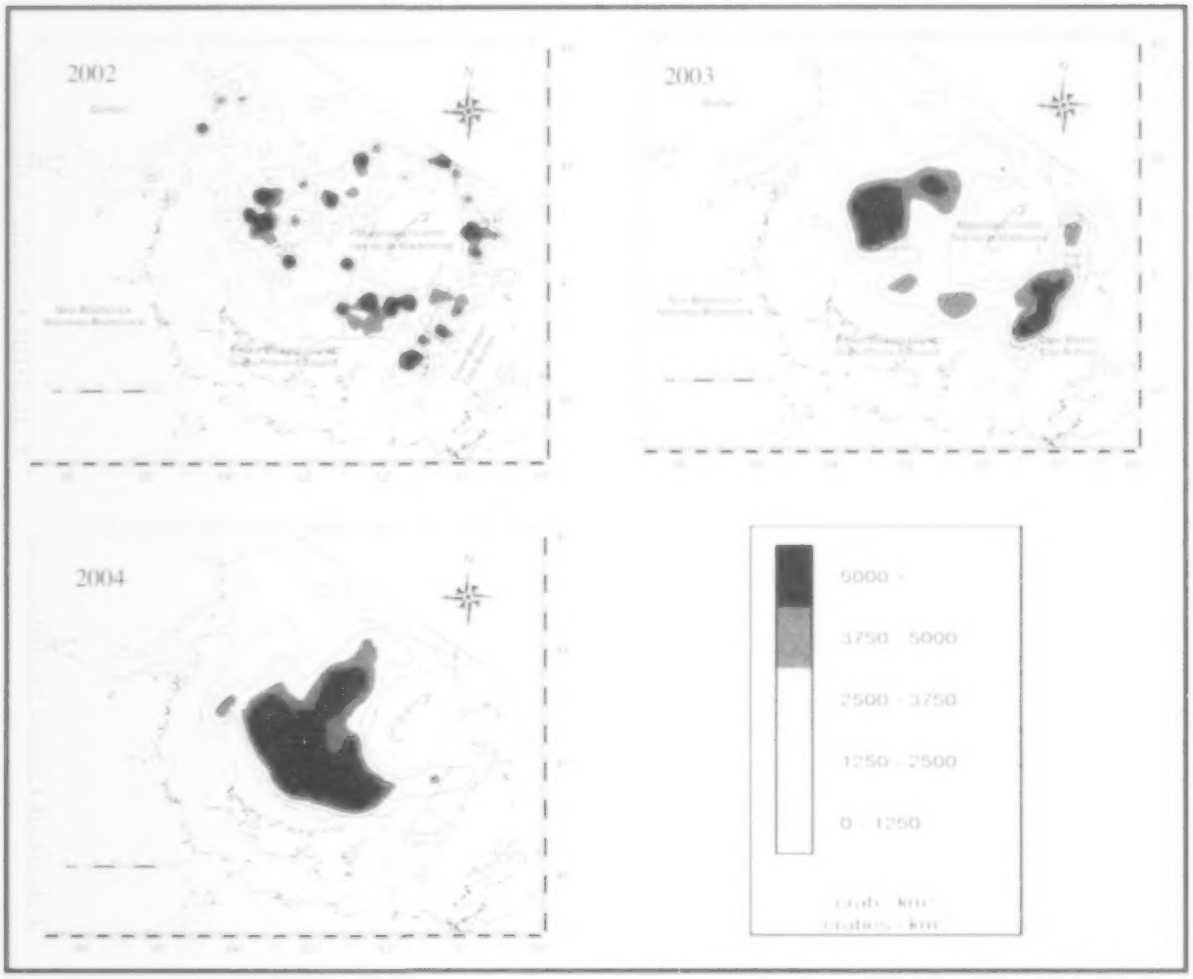


Figure 5: Biomass Estimates

Even an unexploited population of snow crab will go through cycles in abundance and in the ratio of males to females. Appendix II illustrates the effects that harvest rates may have on sex ratios and how these effects may impact reproduction, density dependent maturity and genetic change. Such population dynamics pose a challenge to fisheries management when coupled with uncertain knowledge and the confounding influences of shifting spatial distributions of adolescent male, female and mature male snow crab. Snow crab fisheries management is particularly challenging during the decreasing phase of cyclical changes in abundance. The existing management lines give the impression that snow crab can be managed on local fishing grounds, without concern for what is happening outside the area. In reality, recruitment in a local area may depend on management decisions and biological productivity outside of the local zone.

The FRCC recommends the development of a description of the snow crab stock structure, including an assessment of source-sink areas in order to better understand the links between the various aggregations of snow crab. The FRCC recommends that management and assessment consider such stock structure in decision-making.

Growing understanding of the stock structure need not lead to changes in the management areas. Allocation of catches should be on the basis considered most appropriate but in order to assess the effects of fishing, the information should be analyzed on the basis of biological units. Such an approach may require a decision-making process involving inter-regional communication and discussions between fisheries management and fisheries science.

3.3 Biomass and Exploitation Rate Targets and Limits

Three management strategies have traditionally been considered in managing a fluctuating resource:

- Stabilize the exploitation rate - the proportion of the commercial biomass that is removed;
- Stabilize catch - a constant catch strategy; or
- Stabilize escapement - allow a constant residual biomass of male snow crab to remain after the fishery.

Choosing to stabilize one component implies that the others will vary if the resource fluctuates. A constant catch strategy may appear desirable from an industry perspective, but it would imply increasing the exploitation rate as the biomass decreases, a counterintuitive undesirable effect from a conservation perspective. In addition, it implies expanding considerably more fishing effort when the stock is low, again, a counterintuitive undesirable result from a conservation perspective. Choosing a constant escapement strategy would imply that catch and fishing effort would vary, possibly substantially. In contrast, a constant exploitation rate strategy has several desirable properties:

- in principle, fishing effort would be expected to remain reasonably steady from year to year; and
- the catch would be expected to increase when the stock increases and would be expected to decrease when the stock declines.

A constant exploitation rate strategy by itself, however, would not adequately protect a minimum biomass of males in order to ensure the continued production of fertilized eggs. Under such a strategy, males would continue to be harvested at the targeted constant exploitation rate until the biomass became very low. At present, there are no guidelines for making management decisions that are explicitly tied to snow crab conservation. In the absence of biological targets and limits, management is not based on agreed rules and it becomes susceptible to bias and ad hoc decision-making. In these circumstances, undesirable information can be readily discounted, for example low catch per unit effort data can be ascribed to the influence of bad weather rather than low biomass, resulting in poor assessment and management decisions contrary to conservation and sustainability.

Except in the late 1980s, when target exploitation rates were maintained low under a rebuilding strategy, TACs in the southern Gulf of St. Lawrence snow crab fishery have generally been set in the range of 40–50 % of the annual estimate of the biomass of mature snow crab with carapace width greater than 95mm. This exploitation rate is not based on scientific analyses; it is a consensual value arrived at by harvesters, fisheries scientists and managers as the fishery developed. The FRCC believes that a constant exploitation rate strategy should be developed and applied in snow crab fisheries.

Increases in the abundance of snow crab appear to cause an expansion in their geographical distribution as well as increase their density. The constant exploitation rate strategy assumes that the distribution area remains constant and that density increases proportionately throughout the range. If the distribution area increases proportionately more than the density, it might be appropriate to increase fishing effort in times of high abundance in order to maintain a constant exploitation rate and vice versa. Otherwise, the exploitation rate would be lower at high stock size than at low stock size.

The life expectancy of a terminally moulted male snow crab is approximately five years. After a few years following the terminal moult, the market value of snow crab may decline due to shell discolouration. Natural mortality is believed to increase after terminal moult. Consequently, male snow crab cannot be left to accumulate as spawners, they die of natural causes after a few years. Therefore, from an optimal exploitation point of view the exploitation rate should be such that most male snow crab should be harvested before their carapace deteriorates and their commercial value declines.

The FRCC recommends that biomass and exploitation rate targets and limits be developed for snow crab in order to develop an objective based decision-making framework. Such targets and limits should be based on appropriate biological units. The FRCC recommends that harvest rates be considered in the scientific analysis and that precautionary targets be discussed, agreed and used in management decision-making for snow crab.

3.4 Total Allowable Catches

The primary short-term goal of snow crab science is to provide advice on quota recommendations for the coming year. All snow crab fisheries in the Atlantic region are currently managed by TACs, but the information used to provide the advice varies from area to area. A constant exploitation rate strategy can be achieved with limits on the TAC or the fishing effort. Fishing effort controls demand less information, but effort control systems have several undesirable properties, the race to fish and associated technological advances being among the main ones.

The manner in which snow crab TAC recommendations are developed varies from region to region but all rely heavily on a mix of direct observations from the fishery and from directed fisheries science data collection programs. Much of the data used by fisheries science is presently collected with the assistance of harvesters. Numerical population models, frequently used for other Atlantic fisheries such as groundfish, are not used for snow crab, primarily because of the difficulty in aging snow crab. The empirical approach has been working satisfactorily for snow crab but there are opportunities for improvement.

In the southern Gulf of St. Lawrence and in eastern Nova Scotia, the biomass estimate is obtained from annual snow crab trawl surveys in combination with some additional information gathered on the trends in landings. In the Estuary and Lower North Shore of Québec, trap and trawl surveys are used. In Newfoundland and Labrador, a multi-species bottom trawl survey is used in combination with commercial CPUE, and limited trap surveys. In 2004 a comprehensive post-season trap survey was conducted in the Newfoundland region under a joint industry-DFO project. This survey should improve the basis for setting the TAC in the future. In all areas, information on the occurrence of soft-shelled snow crab and the discard rates are also considered.

Post-season trawl surveys specifically designed for snow crab, such as in the southern Gulf of St. Lawrence, provide reasonable estimates of the absolute biomass. Post-season trap surveys, as in the Estuary and Lower North Shore, provide a relative measure of changes in stock biomass and can be used to adjust existing TACs up or down, under an unknown exploitation rate. It would be useful however, to periodically verify the exploitation rates the TACs are generating through specifically designed experiments.

The trawl survey in the southern Gulf adequately covers the distribution of snow crab. The survey results can be extrapolated to estimate the actual biomass of adult crabs. In this case there is a direct link between the harvest rate and the TAC since the harvest rate is simply the ratio of the landings to the biomass estimate. Unfortunately, on grounds such as the Newfoundland Shelf, where snow crab are found in areas that include rocky bottom, the trawl surveys miss a substantial proportion of the snow crab present. It has therefore not been possible to obtain an absolute estimate of the biomass but rather an indicator of the biomass. In such a situation where the biomass is not known, then the harvest rate is only estimated and the impact of fishing on the snow crab population is more uncertain. Tagging experiments conducted with the assistance of harvesters using hard-shell mature snow crab might estimate absolute harvest rate. In the Southern Gulf, the targeted exploitation rate around 40 % appears to have been beneficial to the long-term sustainability of the resource.

The FRCC recommends that wherever the bottom conditions are suitable, specially designed trawl surveys should be conducted for snow crab. Such surveys enable scientists to quantify the proportion of the biomass that is removed by fishing. Where trawl surveys are not possible, estimates of the proportion of the biomass that is removed by fishing should be derived by other means, such as tagging experiments conducted jointly with harvesters.

Another means to estimate the biomass in the Newfoundland and Labrador area could be the multi-species trawl survey supplemented or replaced by a dedicated beam trawl survey every few years in order to better calibrate the absolute biomass of mature snow crab.

3.5 Regional Assessment Process

Information on the snow crab fishery, both for science and for management (e.g. landings) that is collected and analyzed is presented at Regional Assessment Process (RAP) meetings that are typically held on a region-by-region basis from late January to early March. These meetings vary in size and character across Atlantic Canada and Québec. The RAP provides an opportunity for a review and discussion of the status of snow crab by area in each region. DFO invites interested stakeholders to the RAPs and discussions are open, although in general, the role of harvesters in the discussions is limited. Each region has its own approach to presenting information; some provide scientific data in detail, while others have more general discussions and presentations. Each year,

the meetings review the same data, with little indication of growing understanding of the data. It would appear that a more structured approach to the discussions would permit a more focused analysis of the problems most relevant for fisheries science recommendations meant to lead to fisheries management decisions.

The RAPs provide opportunity for discussion of the available information on the stocks by interested parties however, the process by which decisions are made on the state of the stock is rather ad hoc and there is little external scientific peer review of the process. With few exceptions, there is little agreement about what information would definitively describe a stock in relatively poor condition. The lack of clear guidelines for interpretation allows bias to influence the final interpretation that is applied to the data. The natural human tendency to look for the positive, limits the opportunities for conservation-minded discussion. In particular, clearer quantitative guidelines on decision-making would be helpful. The identification of targets and limits recommended earlier would establish a more objective, rules-based approach to providing management advice and making management decisions.

The FRCC recommends that, in addition to the biomass and exploitation rate targets and limits, guidelines be developed that would be applied for each biological unit that would describe for the snow crab management areas the characteristics of good, average and poor states.

The information available on snow crab varies throughout the Atlantic region and the characteristics of the snow crab populations also differ. The FRCC does not consider it necessary that all snow crab fisheries collect the same types of data. The southern Gulf of St. Lawrence is much smaller and very different from the Newfoundland shelf and what works in one region will not necessarily be appropriate elsewhere. There is, however, insufficient Atlantic-wide discussion of the approaches taken to snow crab science and the interpretation of the data for fisheries management. In particular, there is little regional coordination and communication among scientists within the DFO.

The FRCC recommends that an Atlantic wide snow crab science council, including scientists, industry and fisheries management be formed to review science on snow crab on a regular basis. The purpose of the council would be to improve the flow of information on snow crab science between administrative regions of Atlantic Canada and Québec.

The science council recommended would provide a mechanism for the identification of issues and sharing of solutions in the snow crab fishery. It is expected that such a council would meet at least once every two years. The discussions should be open to fisheries scientists, managers, harvesters and other interested parties to provide for a broad base for the interpretation and discussion of the information on snow crab. The council itself should be made up of representative fisheries scientists from around Atlantic Canada, supported by DFO and the snow crab fishing industry.

3.6 Improving the Scientific Basis for Management

The information available on snow crab and the scientific understanding is not uniform throughout Atlantic Canada. The primary limitation to developing improved understanding is the availability of human resources – time and people - that have been focused on the snow crab resource. There is a general feeling within industry that there is not enough scientific study of snow crab. In the Gulf of St. Lawrence, where the fishery has a longer history of importance and value, there has been a greater relative effort directed towards snow crab, much of it industry funded from the early 1990s. In Newfoundland, and to a lesser extent in Scotia-Fundy, where groundfish species dominated the fishery for a long period, there has historically been less attention paid to snow crab, and other invertebrate species. DFO has been slow to adjust its resources away from the depleted groundfish species to the abundant invertebrates, such as shrimp and snow crab. DFO should consider some local and regional reallocation of resources to ensure that the snow crab fisheries receive the necessary directed (i.e. single-species) and ecosystem science required for sustainable fisheries management.

There remain some fundamental gaps in understanding of snow crab biology, both for the design of a long-term sustainable fishery and for the needs of fishery management on an annual basis. Very little is known about the detailed spatial distribution of snow crab, or the fluctuations of males and females, and mature and immature snow crab as discussed earlier. Much information could be collected through a tagging program that involved harvesters, many of whom expressed a willingness to contribute to such an effort, but it would also require time and effort on the part of fisheries scientists who are presently fully committed to their present science efforts. Most of the current resources appear to be fully

engaged in efforts focused on setting next year's TACs but little science effort is being directed to address the gaps in knowledge.

The information used in analysis is based on many assumptions, not all of which are properly or regularly tested. It is often assumed that the data are captured in an accurate, consistent and timely manner. Data from the fishery have been used primarily to monitor fishery performance. Observed changes in abundance and population structure are usually assumed to be independent of fishing or changes in fishing. Thus changes in the way the fishery operates or the location of fishing activity, often receive little attention.

The data typically used to describe the state of snow crab and the fishery is outlined in Table 1 below. In the table, the primary interpretative characteristic of each indicator and its role in management decisions is indicated. Broadly, the data can provide insight about the performance of the fishery or how the resource is responding to the environment. An economically viable fishery requires that the costs of the information required to ensure sustainability also be considered and therefore, the value of each piece of information needs to be balanced against the costs required to collect it. Fisheries Management processes must consider what minimal information is required to ensure sustainability recognizing that the bare minimum of information may

Indicator Toolbox for Management and Conservation

Class of indicator	Data / information source	Indicator for…		To manage for…		
		Fishery Performance	Resource Health	Exploitation	Recruitment	Reproduction
• Effort • Landings • Catch per unit effort • Effort distribution	• Commercial log books • Observers • Test or sentinel fishery • Scientific trap or trawl survey • Remote observer (Black box)	X		X		
• Commercial biomass • Biomass index	• Science survey		X	X		
• Size distribution	• Science survey but depends on type of gear used (e.g. beam trawl has a good catchability of smaller sizes). • Commercial log book, but limited to legal or near legal sizes (perhaps better indicator than catch rates)		X	X	X	
• Sex ratio • Fecundity • Spermatheca load	• Science survey		X			X
• Shell condition • Soft Shell discard rates	• Commercial log books • Observer • Dockside monitoring • Science survey	X		X	X	
• Biomass and distribution of adolescent males	• Commercial log books (discard • Observer • Science survey		X		X	
• Biomass and distribution of females	• Science survey		X			X

Table 1: Indicator Toolbox for Management and Conservation

not be sufficient given the uncertainties in data and understanding. Sustainability of snow crab fisheries will require more investment in the collection and analysis of information.

Information can be interpreted and applied to achieve different goals. The time-frames on which the data are used provide a framework within which to consider their application i.e., immediate, medium term, and long term. The application of the data can also be considered from a fishery perspective as to whether the information is most useful for exploitation (immediate), recruitment (medium-term) or reproduction (long-term).

All partners involved in the snow crab industry must share the responsibility to contribute to development of a comprehensive scientific basis for the management of the snow crab stocks. As joint stewardship inevitably expands, so too should joint industry/science activity. Presently DFO scientists are the leaders in providing the scientific data upon which the fisheries management TACs are established. Harvesters have played a relatively minor role in the collection and interpretation of information. There is, however, more involvement in some regions (e.g. the southern Gulf) than in others (e.g. Newfoundland). The fall trap survey in Newfoundland represents a very positive initiative. Another possible area of collaboration would be tagging studies for snow crab. Harvesters could make such studies very effective and relatively inexpensive to implement. Not all forms of collaboration require large amounts of money.

Management of sustainable snow crab fisheries requires an integrated approach to the collection of scientific data and the establishment of sustainable harvests. This approach should involve DFO and external scientists and managers working collaboratively with harvesters to ensure that the roles and responsibilities with regard to the management, collection of scientific data, as well as the funding requirements for a sustainable crab fishery are integrated within each area. While improved understanding of snow crab biology is important, it is necessary that such single-species knowledge be placed within an ecosystem context. It is important that ecosystem studies support directed snow crab studies.

The current erosion of the funding base allocated to research and data collection within DFO requires the reassessment of funding priorities. There is an urgent need to develop a funding strategy to ensure that all proponents bear an equitable responsibility in the collection of the scientific information required to support a sustainable snow crab fishery.

The FRCC recommends that the DFO work with harvesters to develop an economically viable program for the collection, integration, analysis and interpretation of scientific data necessary to achieve management objectives in order to improve the understanding of the factors influencing snow crab productivity.

Harvesters, DFO scientists and managers must work within a transparent and equitable co-management process to ensure sustainability. It is important that the at-sea observer program be integrated within this strategy and that harvesters become more active participants in the collection and understanding of data.

Crab pots with escape mechanisms
Paul Winger – Memorial University

4 Protecting the Spawning Stock and Recruitment

4.1 Introduction

Harvesting activities, by their nature, increase the risk that conservation may not be achieved. Harvesting activities must therefore be regulated to increase the probability that sustainability will be achieved. The FRCC has concluded that the main threat to snow crab conservation in Atlantic Canada and Québec is the catch and discarding of immature male snow crab and soft-shelled crab in particular. The immature males are the future recruitment to both the spawning stock and the commercial fishery. They need to be protected to allow them to mate once they have become mature and to be harvested as valuable commercial size snow crab. Increasing the protection of immature male snow crab implies that the capture of soft-shelled and immature snow crab be reduced substantially. This can be achieved through:

- Better matching the fishing season with the moult cycle of snow crab;
- Implementing protocols to close areas where soft-shelled snow crab represents a high percentage of the catch in number;
- More careful handling of the snow crab that will be discarded in order to reduce their post-harvest mortality;
- Improving the selectivity of the fishing gear such that immature and female snow crab are left on the bottom; and
- Reducing the overall fishing effort applied to the resource in order to achieve a sustainable exploitation rate and reduce repeated handling of soft-shelled and immature male snow crab.
- Development of protected areas to enhance the long-term sustainability of snow crab.

4.2 Fishing Season

The snow crab fishing seasons are established each year as part of the annual harvesting plan for each fishing area. The fishing seasons vary significantly depending on the area. The earliest start to snow crab fishing generally occurs in the main fishing area of the Gulf of St. Lawrence. Traditionally, the fishery in this area is conducted during the spring - April through to early summer. In recent years, traditional fleets have harvested the snow crab quotas within six weeks of the season opening. Fishing at this time of year has strategic advantages in that it avoids harvesting during the mating season of first time spawners in late winter and early spring and is at a time when moulting (soft-shelled or white) snow crab is generally not caught.

The harvest season generally starts in early April, or as ice conditions permit, however, fishing seasons can start as late as July and continue through summer until early fall. Late starting fisheries, particularly those around Cape Breton and eastern Nova Scotia, were established to allow harvesters to fish for other species, such as lobster. The lobster fishery is competitive and can represent a significant portion of the annual income of participants. In contrast, individual quotas for snow crab can be fished following other competitive fisheries that occur during the spring. Late starting snow crab seasons can result in a higher risk that catches of soft-shelled snow crab will be proportionately high, one of the most serious conservation issues in the fishery.

Generally harvesters are of the view that the snow crab fisheries should open in early spring as the catch of soft-shelled snow crab during summer months presents a challenge to the fishery and negatively affects conservation. During consultations it was suggested that the seasons should be open concurrently to conserve the snow crab resource and enable harvesters to individually choose how they best prosecute the fisheries available to their individual enterprises.

Delayed openings in the snow crab fishery contribute to the high incidence of soft-shelled crab encountered in the catch. Closures of the fishery due to high soft-shelled catches leaves fishing enterprises with no opportunity to participate and often results in allocations remaining uncaught. Harvesters in certain areas expressed frustration with the management process for the establishment of the TAC that often delays the start of the fishery. Ice conditions can also prevent an early start to the fishery, particularly in the northern Gulf of St. Lawrence and along the coast of Labrador.

There is widespread consensus among harvesters in most areas that the snow crab fishery should open as early as practical in the spring. During consultations participants also expressed the view that there should be a fixed closing date that should not overlap with the period that the snow crab are soft-shelled or in a post moulting stage.

The current timetable for the development of the stock status reports for snow crab by scientists does not take place until late winter. It is difficult for scientists to adjust this timeframe due to the timing of research vessel surveys and the time necessary to collect and analyze data to present at the regional assessment process that involves consultation and input from industry representatives. Given the current consultation and decision-making schedules, DFO should review its timeframe for establishing annual harvesting plans to ensure that decisions can be made in a timely manner to allow the snow crab fishery to commence as early as possible.

The spring snow crab opening date does not conflict with the mating period for first time spawning females that occurs during winter. However, harvesting of mature males during early spring does overlap with the mating of repeat spawning females which takes place through the spring and early summer. The fishery management challenge is to establish a season that balances protection of mating with avoidance of capturing a high percentage of juvenile snow crab that will moult during the summer period. The closing date for the snow crab fisheries should be based on the recognition that soft-shelled snow crabs are particularly vulnerable to handling mortality during harvesting. These moulting crabs are the recruitment to the fishery and if harvested will significantly affect future yield from the resource. Although these snow crabs develop a hard shell following the summer moulting period, the meat content of the snow crab is relatively low and the crab is of little commercial value until the following spring season.

The Council is of the view that the target date for the opening of snow crab fisheries should be April 1st of each year subject to adjustments recommended by science to ensure minimum conflict with the mating period for snow crab in some areas. Consideration should also be given to establishing the early opening date as a component of a multi-year management plan with provision for adjustments related to annual ice conditions. **The FRCC concludes that snow crab fishing seasons throughout the Atlantic region and Québec should be based on the principle of conserving and sustaining the snow crab resource.**

Fishing seasons should therefore, start in early spring (April 1st) and be completed by early summer (July 15th) in all areas where practical. Fishing outside this period should only be conducted in areas where an early start to the fishery is not possible due to ice conditions, e.g. the area off the Labrador coast or where harvesters can demonstrate by a DFO approved fully-observed test fishery that fishing can occur outside these dates without creating a conservation concern. The opening of snow crab fisheries may be delayed due to ice conditions in other areas but such delays should not generally extend the period of the summer when fishing overlaps with the higher incidence of soft-shelled crab in the fishery. Later opening dates should apply to identified areas where other conservation concerns warrant a delayed start to the fishery e.g. spring mating in the Bay de Chaleur area.

The FRCC recommends that snow crab seasons be established with set opening (as close as possible to April 1) and closing dates (as close as possible to July 15), unless harvesters can demonstrate by a DFO approved fully-observed test fishery that fishing can occur outside these dates without creating a conservation concern. Fixed seasons that do not overlap with the moulting period of juvenile males during summer will protect recruitment and enhance sustainability.

4.3 Soft-Shelled Snow Crab

Snow crab is a crustacean with a hard outer shell that is periodically shed in a process known as moulting. Upon moulting, snow crab has a soft-shell for a period of months until it establishes a new hard-shell. Snow crabs that are in this biological stage of growth have little commercial value. The commercial snow crab fishery targets to capture and retain only mature males in the population. Snow crab, unlike lobster, does not continue to moult throughout its life. The males stop growing after their final moult in which they become mature and acquire large claws on the first pair of legs. Large clawed males are the primary targets of the commercial snow crab fishery. High exploitation rates on these larger males in the population results in the removal of most hard-shelled crab and leads to repeated capture and handling of the soft-shelled animals in the population.

A general understanding of the life cycle of snow crab, and the role of moulting, has led to the clear recognition of the importance of minimizing fishery induced mortality of soft-shelled snow crab. The increased presence of soft-shelled snow crab, is often associated with a decline in the absolute abundance of mature, hard-shelled snow crab. Even in cases where the increased abundance of soft-shelled snow crab is due to increased recruitment, fishery induced mortality on soft-shelled snow crab should also be reduced. This concept is well understood amongst traditional harvesters, but all participants in the fishery have not mastered the concept.

Therefore, one would expect this problem to increase as the fishery begins to deplete the available resource of mature snow crab. Application of the precautionary approach suggests that a general increase in soft-shell snow crab over an area, for a persistent period of time, should be taken as a clear warning sign.

Soft-shelled snow crab, or white crab as they are also known, is the future recruitment to sustain the commercial fishery and to mate with the available females. Consequently, soft-shelled and new hard-shell snow crab must be protected to conserve and sustain the resource and the fishery. Soft-shelled crabs have been and continue to be a significant component of the harvest in many areas throughout the Atlantic fishery. In areas where commercial exploitation is high, repeated handling of the soft-shelled snow crab adds to the mortality on the recruiting animals to the stock. The harvest of soft-shelled snow crab also results from poor fishing strategies that allow fisheries during times of high abundance of soft-shelled crab. Soft-shelled snow crab harvested during these periods is susceptible to very high fishing mortality. An illustration of the effects that harvesting soft-shelled snow crab may have on the yield from the resource at differing exploitation rates and varying soft-shelled mortality is depicted in Appendix III. The illustration demonstrates the importance of minimizing the harvest of soft-shelled crab in order to optimize the yield from the resource.

Throughout discussions with the FRCC, participants expressed the view that one of the greatest threats to the sustainability of the snow crab resource was the need to address the high incidence of soft-shelled crab being harvested in the fishery. Harvesters that fished in areas where the incidence of soft-shelled crab was particularly high indicated that up to 90% of the catch was comprised of soft-shelled crab. Indeed, the large majority of participants in the fishery concur with the observation of fisheries scientists that most of the soft-shelled crab captured in traps do not survive when returned to the water. Harvesting these soft-shelled crabs is a waste of the resource and represents a significant threat to the conservation of snow crab stocks. This practice must stop immediately.

Traditional snow crab harvesters from the Gulf of St Lawrence have noted that the significant resource decline in the late 1980s coincides with "excessive catches of white crab." This period of resource decline was followed by a comprehensive re-building strategy on the part of industry and DFO that led to the establishment of a soft-shell protocol to conserve and protect the snow crab during the moulting stages of development (see Appendix IV). This protocol requires that a continuous process of at-sea monitoring regulate snow crab fishing activity. The monitoring must cover the entire distribution of the resource over the fishing season to be effective. The protocol is designed to monitor each area of the fishery based on a system of pre-determined grids of equal size. If 20% of the catch in any grid is comprised of soft-shelled crabs then that grid is closed. This soft-shell protocol was initially instituted in the Gulf of St. Lawrence in 1990 and when combined with an efficient observer program, has been demonstrated to be an effective means to conserve and protect the snow crab resource.

Sufficient at-sea monitoring is key to reducing the mortality caused by the catch and subsequent discarding of snow crab in areas where the incidence of soft-shelled crabs is high. The monitoring of approximately 30% of the total fishing activity on the traditional snow crab fishing grounds in the Gulf of St. Lawrence has proven to be effective. Through continuous monitoring, grid areas are closed in accordance with the protocol and these grid closures remain in place for the remainder of the harvesting season. This well established protocol is now being implemented in other areas of the Atlantic fishery. The at-sea observer program is discussed later in the report.

Industry representations during public consultations focused on the fact that grid closures to protect soft-shelled crab are ineffective if fisheries that use bottom contact gear, such as for groundfish, shrimp, surf clam, etc, are allowed to take place. Many stakeholders suggest that conservation strategies such as area closures should apply to all gear types where there is a presumed influence on snow crab. Harvesters indicate that certain gillnetting activities and fishing gears that disturb the ocean bottom, such as trawling, are of particular concern to the conservation of snow crab. DFO has ongoing research to determine the effects of trawling activity on the snow crab resource. **The FRCC has concluded that as a precautionary measure area closures to protect soft-shelled snow crab should apply to other fisheries in the closed area, particularly gillnetting that impact on snow crab conservation and fishing gears that have bottom impacts.** These closures should cover the period that snow crab remain in a post moulting stage and should be determined through consultation with stakeholders and appropriate field-testing.

During consultations harvesters indicated that there are certain known areas where snow crab is soft-shelled even in early spring. They suggest that these areas should be closed to the fishery at all times of the year

in order to conserve and protect snow crab stocks. Further scientific studies on the spatial characteristics of soft-shelled snow crab would be helpful to improve the effectiveness of management protocols to limit their appearance in the fishery.

In order to acquire the information necessary to protect soft-shell snow crab, the FRCC recommends that scientific studies be supported to determine the spatial dynamics of soft-shelled crab in Atlantic Canada.

The FRCC notes that harvesters of snow crab in a number of snow crab fishing areas are heavily exploiting soft-shelled snow crab. It is also noteworthy that area grid closures, during the fishing season, caused the fishing effort to become more concentrated within portions of the area where the fishery remained open. The very high incidence of soft-shelled crab in the harvest resulted in complete mid–season closures. In some fishing areas, the fishery was re-opened after the closure even though most industry stakeholders recommended that the fishery remain closed for the remainder of the season. In the Council's view, the reopening of fisheries results in the capture of a high percentage of snow crab that have low commercial value and from a conservation perspective these areas should remain closed to protect recruitment that will support the future fishery.

The Council is concerned that the fishing practices in a number of snow crab areas is not conducive to the sustainability of the fishery. It is a priority that such poor fishing practices change, as they will significantly increase the probability of resource declines. Poor fishing practices will exacerbate the normal cyclical resource declines and will impede the productivity of snow crab stocks in areas where such practices prevail. Fishing induced declines resulting from poor practices were experienced in the late 1980s as reported by traditional harvesters in the Gulf of St. Lawrence. Precipitous resource decline can occur over a very short time scale when low natural productivity in the stock is combined with high exploitation rates and high un-reported fishing related mortality on immature soft-shelled crab. The combination of low productivity and high exploitation rates appears to be evident in areas off Newfoundland and off eastern Nova Scotia. Participants who have not lived through the declines of the 1980s may not fully appreciate the importance of good fishing practices in order to protect incoming recruitment. Dramatic declines are certainly possible and could have devastating consequences for many people and rural communities in Atlantic Canada.

The FRCC has concluded that the avoidance of soft-shelled crab is of paramount importance to sustainability. A comprehensive strategy must be developed by fisheries managers in consultation with harvesters in regard to protecting and conserving soft–shelled snow crab.

The FRCC recommends that the 20% soft-shell grid based protocol as implemented in the Gulf of St. Lawrence be established for all snow crab fisheries.

The FRCC recommends that the at-sea observer program establish as its primary objective the monitoring of soft-shelled crab in the commercial fishery. At–sea monitoring should ensure adequate observer coverage, over the entire area, throughout the snow crab season to effectively enforce the 20% soft-shelled protocol.

The Council recommends that soft-shell crab closures in any grid area remain closed for the remainder of the season and apply to gillnet fisheries that impact on snow crab conservation and bottom contact fisheries for other species for the period that snow crab remain in their moulting stage.

The FRCC recommends that the Total Allowable Catch be reduced significantly in areas where the biomass of mature male crab is relatively low and the incidence of soft-shelled snow crab in the fishery is consistently above the 20% threshold.

4.4 Handling Mortality

The harvest of snow crab is targeted to capture and retain hard-shelled commercial size mature male crab of 95mm carapace width and greater. The traps used in the fishery utilize a minimum of 5¼ inch mesh also capture incidental catches of non – targeted snow crab such as undersized male crab, female crab and soft-shelled crab. The average incidental catch varies depending on the area fished but ranges from below 10% to above 50%. These non-targeted snow crabs are discarded during the harvesting activity. Harvesters report that smaller sized commercial crab, above 95mm carapace width, are sometimes discarded in the fishery. This practice is known as high-grading and is caused by the higher market prices for snow crab greater than 102mm carapace width.

Collectively, the discarding and handling practices in the industry are a concern to the conservation of the resource due to the high fishing mortality that results.

Currently there are no reliable estimates of the percentage of commercial size crab that are high-graded in the fishery. Dockside monitoring of the commercial landings should be used to compare the size distribution of snow crab landed with the size distribution reported by at-sea monitoring. Comparative analysis of these data would identify the nature and extent of high-grading practices in the snow crab fishery. Increased observer coverage could also assist in monitoring the extent of high-grading practices in the snow crab fishery.

Depending on the harvesting practice onboard vessels the catch is released from a trap onto the deck of the vessel, into the vessels hold, or onto a sorting table onboard. Once onboard all soft-shelled snow crab, female crab, and undersized (less than 95mm carapace width) males are culled from the catch as required by regulation. The culling of the catch may be conducted on an open deck, in a sheltered deck area or in the hold of the vessel. In the process of emptying the catch from the trap, the snow crab can be dropped from one foot to several feet before culling is performed. Where crab is culled in the fish hold of the vessel the drop is generally between four and eight feet. This drop has a significant effect on mortality.

The time that elapses between bringing the catch on board the vessel and the time that non-targeted snow crab is returned to the sea is also a critical factor in the survival of discarded crab. The time that discards are held onboard varies depending on the type of vessel, harvesting practices onboard and the harvesting methods employed. This mortality results from the time that snow crab are out of the water and the rough handling that occurs during the unloading of the traps, culling the crab onboard and returning the discards to the sea.

During 2002, Dr. Scott Grant of Memorial University conducted a comprehensive study on male hard-shelled crab to determine whether the height of drop and the time out of the water influenced the survival of discards. The study showed that instant mortalities were recorded in all of the groups of snow crab subjected to drops ranging from two feet to six feet in height. Mortalities increased with drop height. In addition, the longer the snow crabs were held out of the water the higher the mortality experienced. Some harvesters expressed the view that snow crab is hardy and they do not see the need for treating the crab they discard with any special care. There appears to be a general lack of awareness and training as to the proper handling practices for

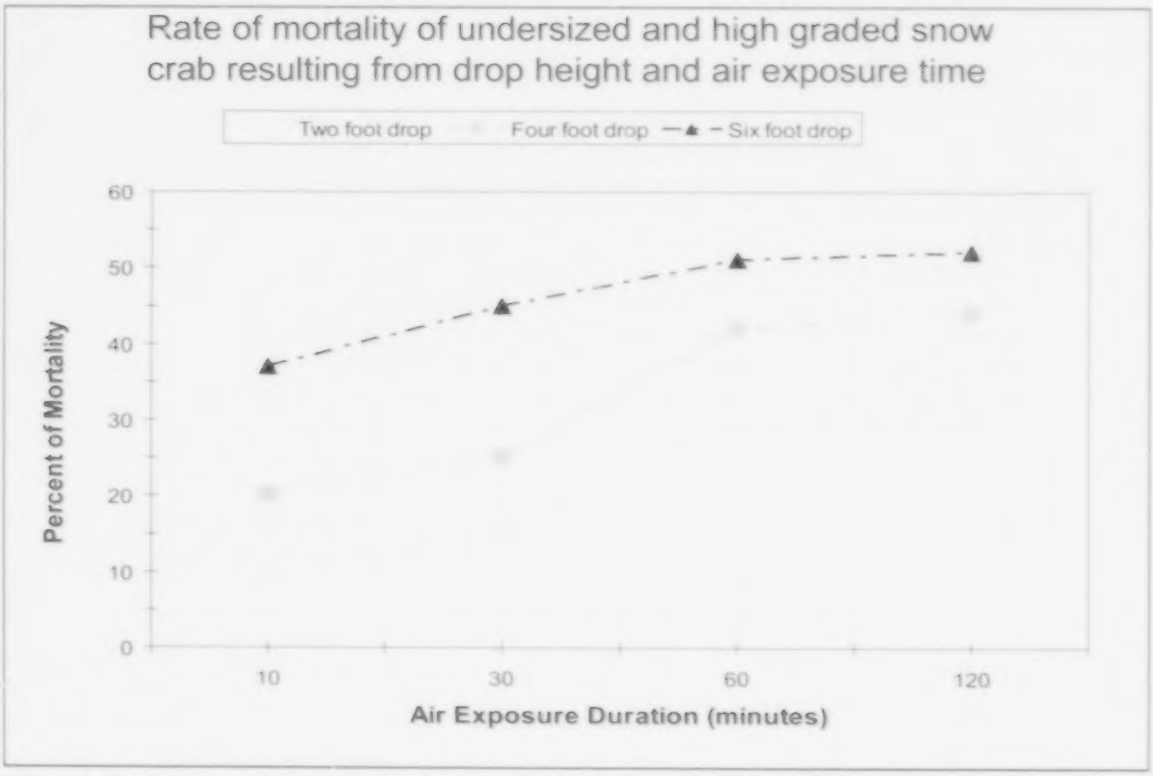


Figure 6: Handling mortality of snow crab

conservation of the resource. Harvesters with more experience have realized the impact of mishandling snow crab and have adapted their vessels and fishing techniques to effectively reduce the mortality incurred by discarded snow crab. These conservation oriented fishing and handling strategies need to be adopted by all participants in the fishery to promote sustainability.

The study also concluded that considerable mortality occurred even after the snow crabs were returned to the water. Total mortality results from the study are summarized in Figure 6.

In conclusion the study results indicate that total handling mortality on hard-shelled males ranged from 10% to over 50% depending on the height of drop and the duration of air exposure. Snow crab dropped as little as two feet and returned to the water within ten minutes experience approximately 10% mortality. Mortality almost quadrupled to 37% when the drop height increased to six feet. Exposure to air increased mortality from 10% to 29% over one hour at a two-foot drop. Over 50% of the hard-shelled male crabs died if dropped up to six feet and exposed to air for periods up to an hour. These mortality rates are considerably higher than those in the control sample of the study that indicated that discard mortality for hard-shelled crab can be virtually eliminated by gently handling the snow crab on board and returning them to the sea within moments of removing them from the traps.

During consultations harvesters indicated that many of the vessels in the fleet were not designed to permit good handling practices. The variability in vessel design has led to a variety of handling and holding methods on board. Unfortunately, many of the harvesters reportedly cull the snow crab in the fish holds of the vessels subjecting the snow crab to drop heights that inflict unnecessary mortality. In addition, discarded crabs are subjected to further drops from the decks of vessels on return to the sea with relatively few vessels using sloped conveying devices to reduce the physical stress on the snow crab being discarded.

Representations during consultations also indicated that harvesters are observed retrieving fleets of traps in sequence, culling the catch in the fish hold, and only returning the discarded crab to the sea periodically. This practice causes undue delays on board and the discarded crabs are subjected to unreasonably long periods of time exposed to air. It has been suggested that the best means to resolve these poor handling practices is through education programs specifically designed for the snow crab fishery. It was also suggested that DFO should be responsible for educating recently licensed harvesters. The FRCC notes that in a number of snow crab areas, harvesters have adopted more conservation-minded handling practices. In certain areas of the St. Lawrence Estuary, for example, harvesters in cooperation with DFO have implemented a practice of returning the small clawed legal sized males to the sea as these animals have not reached terminal moult and represent a potentially significant contribution to maintaining the reproductive capacity of the resource and sustainability of the fishery. The FRCC encourages industry stakeholders and fisheries managers to take similar initiatives to enhance sustainability.

The Council heard from many industry stakeholders that the solution to handling mortality is for DFO to make best handling practices a condition of licence. While harvesters recognized that such a regulation would be somewhat difficult to enforce they indicated that handling practices would significantly improve if such a condition were implemented.

The FRCC has concluded that handling-induced mortality is a significant conservation issue that is adversely affecting recruitment in the fishery. The FRCC endorses the recommendations of the study on handling mortality and recommends that measures be taken to eliminate dropping of discarded snow crab and to reduce the time that snow crab are held out of the water.

The FRCC recommends that industry develop a standard code of practice to reduce the mortality caused by discarding practices. Such a code of practice should focus on effective and timely means to return snow crab to the water and should be adopted as part of a conservation harvesting plan for the snow crab fishery as well as be included as a condition of licence.

The FRCC recommends an industry-training program be developed and made mandatory to demonstrate best handling practices to assist in developing awareness and improving education for harvesters.

4.5 Snow Crab Fishing Gear

Snow crab fishing gear has remained relatively unchanged since the development of the fishery in the late 1960's. During the FRCC consultation process many stakeholders questioned whether the selectivity of the mesh in snow crab traps is optimum. Research is currently exploring improvements in gear design aimed

at enhancing escapement for undersized snow crab and inhibiting the capture of soft-shelled snow crabs. Some of the ideas being tested include: rigid bands around the upper portion of the trap that would limit the size at which snow crabs are able to scale; and enter the trap; and fixed rigid escapement windows in the lower portion of the trap.

Industry representations to the Council suggested that the current regulation mesh size is too small and causes traps to retain too high a percentage of non-targeted snow crab. Harvesters also indicated that the soak time (the time that traps are left fishing in a baited condition) has a significant affect on the numbers of snow crab that have to be culled from the catch and discarded during harvesting, with longer soak times reducing the snow crab that have to be discarded. A recent study by David Taylor of DFO investigating the influence of mesh size and soak time concluded that with the use of 5½ inch mesh traps and a soak time of three days, the resulting catches were comprised of a higher proportion of legal size snow crab and reduced the unnecessary capture and discard of undersized snow crabs. Lengthy soak times appear to be an effective means to improve conservation however, industry participants note that it is impractical to have traps soak three days.

Scientists suggest that increasing the mesh size in traps will cause the industry to further target a higher percentage of larger sized males. They indicate that a significant number of male crab reach final moult and maturity at carapace widths below the current 95mm regulation. Further selectivity of larger males could cause a shift in population distribution, as a higher percentage of the male population would be comprised of smaller animals that would likely be sexual partners with mature females in the population. Biologically speaking it may be optimal to regulate a fixed mesh size to avoid shifts in male selectivity if only for commercial reasons.

Currently the industry utilizes a range of mesh sizes in traps from the minimum 5¼ inch to as high as 6 inches. The DFO in the Gulf region has recently completed an analysis of the selectivity of various mesh sizes for traps and has concluded that the mesh size regulation will change in 2006. The new regulation is to specify a single mesh size of 65mm (minimum and maximum mesh size) as measured from the inside of one knot to the outside of the other knot on any one side. **The FRCC supports the new regulations that aim to minimize the capture of undersized snow crab and reduce targeted exploitation of males well above the legal-size.**

Another recent study, conducted by Dr. Paul Winger of Memorial University, evaluated the feasibility of escape mechanisms in conical shaped traps as a means of improving size selectivity. The escape mechanisms used were rigid selectivity devices that provide non-targeted snow crab an opportunity to escape before the trap is hauled. These types of mechanisms are commonly used as selectivity devices to minimize the capture of undersized animals in decapod fisheries and have proven to be effective in commercial crab and lobster fisheries throughout North America. The study found that the optimal escape hole diameter was 99mm for the selection of snow crab 95mm carapace width and greater. The results of the study showed that snow crab <95mm are capable of successfully detecting, approaching and entering the opening with different parts of the body, by orienting their carapace to achieve escapement. In addition to hole size, the study determined that the location and number of holes are important factors to minimize the capture of undersize animals. **The FRCC supports the further investigation of rigid escape mechanisms for the commercial snow crab fishery.** The study results should be confirmed through comparative at sea experiments to demonstrate commercial application. Upon repeating the results during at sea testing DFO should work cooperatively with industry to implement regulatory changes that would facilitate progressive changes to the trap design to allow for the use of rigid escape mechanisms in the snow crab fishery.

The Council encourages industry and DFO to continue to pursue gear development initiatives that target to reduce the capture of undersized and soft-shelled snow crab. An approach to assist gear development would be for industry groups throughout Atlantic Canada to meet bi-annually to establish research priorities to improve the selectivity of fishing technology and adopt new developments that enhance resource conservation.

The FRCC recommends that the industry and DFO adopt mesh size regulations that minimize the capture of undersized snow crab and reduce the targeting of the larger size males in the population. In addition, the Council encourages industry and DFO to explore new trap designs that would enhance escapement for snow crabs not targeted by the fishery.

During its consultations the FRCC received a number of representations in regard to the loss of fishing gear in certain fishing areas. Shrimp trawlers in the offshore industry noted that it is a common occurrence to retrieve snow crab traps in trawls off the northeast

coast of Newfoundland. Comments from stakeholders suggest that lost traps continue to capture snow crab for prolonged periods. The Council was advised that in certain areas of the fishery the industry has adopted, and DFO requires through regulation, that mesh panels be installed in each trap with bio-degradable twine. In the event that the trap is lost during fishing the twine is designed to deteriorate within a number of weeks, creating a large hole in the trap through which crab and other fish can escape.

The FRCC recommends that all snow crab traps be required to contain mesh panels composed of bio-degradable twine. DFO should facilitate this change by demonstrating its purpose and implementing common regulations throughout the Atlantic snow crab fishery.

4.6 Harvesting Capacity

The snow crab fishery has been prosecuted in Atlantic Canada for approximately 40 years. For most of the first three decades of the fishery, participation was limited largely to a so-called 'full-time or traditional' inshore snow crab fleet. Despite limiting the number of licensed enterprises and the number of traps deployed, the snow crab resource declined sharply in many areas during the late 1980s due to a combination of poor fishing practices and cyclical changes in abundance.

Following the collapse of most groundfish stocks in the early 1990s the snow crab fishery expanded considerably. New fishing grounds were explored but, as is often the case, fishing capacity outpaced the growth of the snow crab resource. In the Maritimes and Québec the number of fishing licences rose from about 500 in 1992 to more than 1000 in 2004. Meanwhile the number of snow crab fishing licences in Newfoundland and Labrador increased from about 70 in 1980 to 750 in 1992 to over 3,400 in 2004 (See Appendix V for a profile of number of licences and current capacity in the Atlantic snow crab fishery).

Some snow crab areas are particularly affected by decreasing resource abundance. Harvesters indicate that DFO is overly influenced by political motivations rather than managing the fishery on a conservative and sustainable basis. It is also noted that in a number of areas fishing effort has become more and more concentrated due to increases in the number of fishing enterprises and localized depletion of snow crab within the area. **Based on stakeholder comments and available scientific information, the FRCC concludes that virtually all snow crab habitat has been fully explored in Atlantic Canada.**

Under ideal conditions, the TACs would be set based on perfect information to establish a predetermined precautionary target exploitation rate; monitoring, control and surveillance would ensure that catches were exactly as determined; and fishing practices would be universally responsible. In an ideal world, overcapacity in the fishing fleet would not be a problem. Unfortunately, TACs are not set on perfect information, particularly in areas around Newfoundland and Labrador; monitoring, control and surveillance is far from sufficient to ensure that catches exactly match the TAC; and fishing practices can be significantly improved. Therefore, the TAC is not sufficient to prevent over-fishing of snow crab and the harvesting capacity must be better matched with the available resource. It appears that a rebalancing is required.

Views expressed at consultations indicated that the number of fishing licences and number of traps deployed in the fishery must continue to be limited in order to effectively control fishing effort. Other representations noted that while capacity increased during the expanding years of the fishery, there are no defined rules or strategies to rationalize fishing capacity during periods of resource decline. While there was consensus that an effective capacity rationalization strategy is required, there were varying views as to the best strategy to accomplish capacity reduction. Harvesters suggested rationalization tools include - individual transferable quotas (ITQ's), combining of enterprises, and industry-funded fleet buy-outs. The FRCC has concluded that the tools to reduce fishing capacity should vary based on fleet preferences by fishing area.

Fleets throughout Atlantic Canada are highly dependent on snow crab. Most snow crab licensed enterprises rely on the species for the majority of their income and in some areas fishing enterprises depend on snow crab for between 90 and 100% of their income. The expected resource declines in Newfoundland and in eastern Nova Scotia or decreases in market prices will jeopardize the economic component of sustainability for many participants in the snow crab fishery.

Given the very high dependence on snow crab any material decline in the resource or market returns will cause severe economic hardship. In the absence of self-rationalization mechanisms within the industry, participants will likely react to resource decline by blaming

the situation on fisheries managers, politicians, and DFO in general. Indeed these signals are already developing in areas where the resource has been depleted and significant reductions in TACs, or closures to fishing, are in place. DFO and other government departments must be cognizant of the pressures that will develop to solve the failures of certain fleets by providing access to other fishing areas. Typically, when resource decline occurs fleets in the affected area focus on: expanding fishing effort through increasing the trap hauls in the fishery; increasing the number of traps deployed; gaining access to other fully exploited stocks; and attempting to change the management regime to allow fishing effort to shift to more productive fishing grounds for the same species. The snow crab fishery in many areas is now characterized by increasing fishing effort, declining catches per unit of effort, high exploitation rates, and socio-economic and political pressures to maintain TACs unsustainably high. These factors combined with poor fishing practices and increasing numbers of traps used in many areas pose significant threats to the bio-ecological and economic components of sustainability.

The FRCC recommends that the number of participants in the snow crab fishery be capped at the current number of participants and that current trap limits be maintained where fishing capacity is considered to be sustainable.

The FRCC recommends that DFO work with various fleet sectors to develop effective mechanisms on a fleet-by-fleet, area-by-area basis to reduce fishing capacity. Such mechanisms should contain targets for capacity reduction as well as some form of free and open transferable fishing entitlement up to an agreed aggregate limit to achieve long-term viability. Priority should be given to known areas of resource decline and in areas where resource indicators signal a declining trend. In the Council's view, the Newfoundland and Labrador based fleets and those of Eastern Nova Scotia particularly, should make this an immediate conservation priority.

4.7 At-Sea Observers

The observers who monitor the snow crab fishery operate independently and are contracted and accredited by DFO. The program's primary focus appears to be enforcement although information collected by observers is also used in the regional assessment process. The program has a broad mandate to support "conservation and protection, science and fisheries management".

The FRCC heard repeated comments and complaints about the observer program, notably from the industry in Newfoundland and Labrador. The Council recognizes that there are significant regional differences in the operation and efficacy of the program.

Monitoring by observers of the high incidence of soft-shelled crab in 2004 led to the closure of many fishing areas. Despite the closures, however, harvesters reported that at-sea monitoring is inadequate with little or no monitoring taking place in certain areas. While observer coverage in the Gulf is as high as 30%, coverage in other areas is reportedly as low 1%. At such low observer coverage soft-shell closures cannot be expected to be an effective means of protecting snow crab under current fishing practices.

Funding of the at-sea observer program as currently structured needs to be reviewed. The Council accepts that the operational costs of some aspects of fisheries science and management be borne by the industry. However, program funding that is tied to increases/decreases in the TAC is not sustainable when the need for information may grow while the fishery declines. Therefore, funding is not balanced with the needs of the fishery since the greatest need is typically when the resource is declining or at a low level. Another common complaint was the lack of industry participation in the management of the program. Harvesters felt that, since they were contributing funding to the program, they should have some say in its design and operation.

A review of the purpose and mandate of the observer program would appear to be in order. It is difficult to see how an observer on board a vessel can fulfill a role as an observer, collecting information with the support of the harvester, and also play a fisheries enforcement role. This conflicting mandate seems a fundamental issue to be resolved.

The program needs improvement and its mandate requires review. The FRCC is of the view that a primary objective of the program should be the monitoring of the soft-shell protocol as recommended earlier. At the same time, the Council recognizes the need for the collection of information for science and for other aspects of fisheries management. In a number of areas there is substantial dissatisfaction with the program. While the Council was unable to develop clear recommendations for improving the observer program it did conclude that change was necessary.

The FRCC recommends that the DFO work with the industry to redefine the mandate of the observer program to clearly define its goals. DFO and industry must also agree on how best to fund and operate the program with the goal of improving its efficacy and ensuring better cooperation with and support from harvesters and improved value from the information collected.

4.8 Reserves and Protected Areas

There is much uncertainty in fisheries science and fisheries management. Even with the best of intentions, and best efforts, stock collapses can and do occur. There is therefore growing recognition of the need to enhance the bio-ecological component of sustainability through the establishment of reserves and protected areas that will act as a buffer to protect from the unintended consequences of decisions made with imperfect knowledge.

4.8.1 Protecting mating

The current fishing seasons occur after the first-time spawning females mate during the period from January to March, but they do overlap with the mating of repeat spawning females which takes place through the spring and early summer. Delaying the fishing seasons to after the mating of repeat spawning females is not desirable because it would have negative affects on recruitment and increase the mortality on soft-shelled snow crab. Localized depletion of male snow crab larger than 95mm carapace width could have detrimental effects on the fertilization rates of repeat-mating females. The impact of fishing on reproduction and mating should, obviously, be minimized.

In order to evaluate and minimize the possible negative impact of fishing during the mating period of repeat spawning females, the FRCC recommends that mating areas and times be identified and that these areas be closed to fishing where significant depletion of males is identified.

4.8.2 Refugia

Over the past few decades the fishery has expanded to cover what is now believed to be the full range of snow crab habitat in the Atlantic region. There are no longer any unfished areas to act as buffers in the event of severe depletion due to fishing. There are no reserve populations in the ecosystem 'bank' to mitigate the unintended consequences of management decisions based on imperfect information. Such refugia would preserve some residual reproductive potential, and additional benefits could arise if a protected area is closed to all fishing that alters the habitat, e.g., bottom trawling. If habitat is preserved, and all species in the marine ecosystem are also protected, then ecosystem services are also better protected.

The general principle of ecosystem preservation to enhance sustainability has broad acceptance in terrestrial systems, where parks and reserves are quite common, but the understanding of its potential and application in the ocean is more limited. Presently, there are some areas in Atlantic Canada in which there is restricted fishing, e.g. Western Bank on the outer Scotian Shelf and in Hawke Channel on the Northeast Newfoundland Shelf, but permanent closures are not, so far, in widespread use. Some of these areas are simple closures others are referred to as Marine Protected Areas (MPAs) the purpose of which is defined and laid out in the Oceans Act. MPAs for crab have been tried elsewhere, for example blue crab in Chesapeake Bay, which provides half of the blue crab landings in the United States. In this case a substantial region of Chesapeake Bay was closed to fishing to protect adult female crabs either en route to or at the spawning grounds. Closures for fishing have also been applied on Georges Bank and while these closures were primarily directed towards demersal fish, they covered all bottom gear, including scallop dredges. On Georges Bank, the biomass increases for scallop were greater and occurred considerably more quickly than expected.

Organisms that are relatively immobile, such as snow crab and scallops, make good candidates for reserves since it is possible to directly regulate the impact on the adults and on their reproduction, but it is not possible to protect snow crab during the larval dispersal phase. The FRCC believes that for a relatively sedentary species like snow crab, refugia could provide a buffer to mitigate the limited knowledge of the factors that control snow crab production. It is important however, that reserves be developed with the support and involvement of all stakeholders. Developed poorly, closures can exacerbate conflict and lead to non-compliance and the failure of the initiative. A process of development must be open, inclusive and transparent, with the goal of optimizing the ecological productivity and enhancing sustainability.

As a buffer to protect against the unintended consequences of management decisions based on imperfect information, the FRCC recommends that DFO work with all stakeholders towards the development of a network of reasonably sized and spaced reserves to protect the long-term sustainability of snow crab.

4.9 Male Targeted Fishing

The snow crab fishery targets males above a certain size. Conservation is probable because most male snow crabs are allowed to reach maturity before they are retained and most females are small enough to escape through the meshes of the traps. There have been some situations where males have been locally depleted, temporarily giving rise to concerns that there may be too few males present to adequately fertilize the females, but there are also possible long-term effects of removing the large males from the populations. Some of the males below 95mm carapace width are mature and capable of mating. Over time, if fewer of the large males are available to mate, and the smaller males do more of the mating, then genetic drift of the population may occur and the average size in the male population could gradually decrease to below 95mm.

It is not known if male snow crab becomes mature at a size smaller than 95mm carapace width because of genetic factors, environmental cues, or density dependent factors. If the causes of early terminal moult (below 95mm carapace width) are environmental or density dependent, medium to long-term decreases in the average sizes of male snow crab due to heavy exploitation of large crabs are not necessarily a concern because a reversal of the cause would reverse the effect. However, if the cause is genetic, a decrease in the average size of male snow crab because of high exploitation rates on large snow crab could be expected in the medium to long-term and this would be a cause for concern. Management should ensure that immature snow crab with a carapace width larger than 95mm are allowed to grow to their terminal moult.

Crab size: female (top) vs. male (bottom)
Snow Crab Section, Oceans and Science Branch, DFO, Gulf Region, Moncton, N.B.

In order to evaluate the likelihood of a long-term decrease in the average size of the male snow crab population due to fishing only males larger than 95mm carapace width, the FRCC recommends that science monitors the size at terminal moult for male snow crab, and assess the likelihood that observed changes may be caused by fishing.

5 Modernizing the Management of Snow Crab Fisheries

5.1 Introduction

The current fisheries management structure in Canada is the subject of ongoing debate. Centralized decision-making is a source of much dissatisfaction within the industry. Stakeholders are seeking participatory roles in the management of fisheries and wish to be engaged in more open, transparent decision-making structures. The FRCC shares a vision of decentralized management with shared responsibility and accountability in Atlantic fisheries. The discussion that follows focuses on management issues that need to be addressed for snow crab fisheries and makes strategic recommendations that will achieve shared decision-making with stakeholders through open and transparent processes. The FRCC strongly believes that long-term sustainability of the snow crab fisheries can be enhanced through changes in management.

5.2 Context

Fisheries management in Atlantic Canada is a challenging task. The challenge is to manage the diverse cultural aspects of the industry in an ever-changing and uncertain environment; to manage the interests of numerous stakeholders; and to deal with the many political aspects that play an integral role in fisheries management. It is important to understand the context in which fisheries management decisions are made.

While the snow crab fishery is relatively recent, fisheries in Atlantic Canada are more than mere economic activities to those engaged in their pursuit. The fishery is rooted in history and culture and the people throughout the industry are fiercely proud of their participation. In many communities, the fishery is the sole economic activity. As a result, fisheries managers must be aware of the impact of their decisions on people's lives and give due consideration to its more than five centuries of history.

Elements of the conservation decisions in fisheries management are based on scientific advice. Unfortunately, there remains uncertainty around the factors that influence fishery productivity and particularly how exploitation affects that productivity. Although knowledge of how fishery resources react to exploitation has increased, fisheries managers often have to make decisions that require more information than current scientific knowledge provides.

The participants in the fishery have organized into special interest groups. Over the years numerous fishing associations have started in the Atlantic region. They vary from large, well-financed and influential groups to many smaller organizations based on community or gear-type affinities. The fragmented and conflicting views from the various groups complicate the task of fisheries management. Fixed positions from so many diverse groups can make it difficult or impossible to find consensus on important issues.

Then there is the political influence on fishery management. Decision-making is largely vested in the Minister and the participating groups quickly learn that the best way to win favour is to engage in political lobbying, completely bypassing the consultative management process. An organization with a significant power base can influence the decision-maker and have its view adopted, even though it may not be in the best interests of the fishery or of the other participants in the fishery. Stakeholders generally focus on short-term issues, usually related to additional resource access at the expense of other participating groups.

Finally, there is increasing pressure from non-governmental, environmental and community groups to become involved in the fisheries management process. It seems only natural and appropriate that Canadians at large wish to partake in the management of industries that exploit public resources. Provision should be made for their participation.

It is hardly a surprise that in a broad context, fishery management is frequently under attack. Many argue that the structure must change in favour of one where industry and government share the responsibility and accountability for fisheries management. Often fishing interests express frustration with the minor role they play in the management of the fishery, however, most of these interests must adjust to more open, transparent structures if they are to be responsible and accountable for the management of public resources such as snow crab.

The FRCC was reminded throughout its public consultations that the management of the snow crab fishery is no exception to the broad context outlined above.

5.3 The Current Landscape

5.3.1 Snow crab management

DFO has advisory committees through which it conducts detailed consultations on a wide variety of fisheries management matters. The Council noted that generally there are four types of fisheries management models in use with respect to the management of snow crab fisheries:

Traditional Model

The traditional model consists of the well-known DFO advisory process. Species advisory committees are composed of the stakeholders in the fishery – mainly licence holders, processors and usually provincial representatives as well. Consultations are held following the scientific evaluation of the stock prepared during the Regional Assessment Process (RAP). Competing industry views during consultations are common and consensus is rare. DFO staff summarizes the discussions, add their own perspectives, and prepare confidential recommendations for approval by higher management in DFO. Following the staff recommendations, industry groups frequently engage in lobbying DFO and the Minister, and political influence can have an impact on final decisions. Recommendations are unknown by the stakeholders. Significant decisions such as the total allowable catch, access, licences, etc. require Ministerial approval. The fisheries management plan is announced once the Minister or DFO manager has made decisions. The management plan is often a last minute announcement that is not widely accepted and often results in significant conflicts among industry participants.

'Goodwill' Model

The 'goodwill' model is based on well-developed rapport between a number of like-minded harvesters in an area and DFO. The management plan is developed through discussion and a cooperative approach prevails. There can be no formal structure to the relationship or there can be agreed guidelines that govern the composition of the participants, the mandate and a process for the development of the management plan. Once agreement is reached on the main elements of the plan, DFO manager guides the plan through the DFO approval process. Participants seem content with this process and the approved plan generally has wide acceptance. This model is used sparingly but appears to work in some localized coastal areas of Québec and Newfoundland.

Formal Co-management Model

The co-management model is characterized by a formal agreement between harvesters and DFO. A management board is established which identifies the participants and defines the roles of the parties. An incorporated association represents harvesters. A formal agreement sets out the process for discussion and agreement on issues as well as an agreed formula for sharing increases and decreases to the TAC. Recommendations are noted and presented in unedited form to the decision-maker. Depending on the structure, decisions can be approved by area or regional fisheries managers. Agreements are for a fixed term with options for renewal by mutual consent. Except for problems concerning access and allocation, participants involved in this process appear highly satisfied. An example of the co-management model exists in Crab Fishing Area 19.

First Nations Management Approach

A fourth approach to snow crab management is that taken by First Nations people. Following the Sparrow and Marshall court decisions, the Government of Canada revised its policy with respect to the inclusion of First Nations people in the fishery. As a consequence, First Nations harvesters have become an integral component of the commercial fishery. The First Nations people have developed an interesting communal approach to benefits from the snow crab fishery. The economic returns from fishing are not only shared among harvesters but also among the First Nation communities to assist in the development of social and economic infrastructure. Whether due to this practice or a general attitude of First Nations, the Council found that native participants seemed more attuned to the conservation imperatives of fisheries management than to the economic returns.

These four management models form a continuum – from one of exclusive DFO control over the process and the result, to one where the participants have meaningful input. It is important to note, however, that none of the existing management structures involve joint or shared decision-making. The role is an advisory one only and there is no obligation on the decision-maker to follow the recommended course of action. The Minister can at any time, alter or withdraw from management arrangements solely at the Minister's discretion. Only legislative change can alter this balance of authority in the DFO-industry relationship.

5.3.2 The Legislative Framework

In order to fully appreciate the complexity of fisheries management it is necessary to have a basic understanding of the legislative framework. Canada's constitution grants the exclusive legislative authority for the management of fisheries to the Government of Canada under which Parliament enacted the *Fisheries Act* (the *Act*) in 1868. The *Act* grants decision-making authority to the office of the Minister of Fisheries and Oceans. Quite apart from the administrative bottlenecks of this structure, it places an enormous burden on a single individual to make many localized decisions that affect the livelihoods of thousands of people in hundreds of coastal communities. The Minister has a duty to make responsible conservation-based decisions, however, ministerial decisions must also take into consideration the economic, social and political impact of actions. This centralized decision-making structure imposes significant complexity in the management of the fishery. It is noteworthy that the fishery is based on a common property resource and the Minister is accountable to the public for its protection and the equitable distribution of its benefits. It is a challenging task to find the right balance.

5.4 The Issues

The Council has identified four critical issues with respect to fisheries management that must be addressed in order to achieve a functional management regime. Options to address each of these issues are outlined in this report.

1. The pace toward shared-stewardship in the fishery is too slow. Although progress has been made and DFO appears committed to the concept, it is time to accelerate the process. It should be noted, however, that industry participants are somewhat suspicious of DFO and each other's motives in regard to shared-stewardship. Some participants have had bad experiences with the concept of shared management (notably in Area 12) and others see it as a ploy to get more funding from industry for science, enforcement and management. Many harvesters doubt that DFO has any real intention of sharing responsibility and authority. Much consultative discussion needs to be done by both parties to instill trust and develop a cooperative approach.
2. The substance of decisions is frequently unsatisfactory. Harvesting rules are often inconsistent and conservation can yield to demands for access, poor harvesting practices, quota increases and/or a desire to harvest stocks that are in a vulnerable state. The introduction of thousands of new entrants into the snow crab fishery without any apparent analysis is an example. For a variety of reasons, including government and industry imperatives, it appears to be virtually impossible to announce a timely management plan prior to the start of fisheries in the spring. Untimely plans for the snow crab fishery not only cause operational difficulties for the industry, but late starts extend the fishing season into the critical mid-summer period when snow crab are moulting and vulnerable to increased handling mortality.
3. One of the most significant issues in fisheries management is the lack of transparency in decision-making. Annual recommendations and analysis of management options are developed within DFO and are presented to fisheries managers and the Minister in private. The lack of transparency creates mistrust and erodes confidence in the management system. It is well known that lobbying and private meetings with the Minister and Members of Parliament occur and most stakeholders have an uneasy feeling about the impact of these discussions on the decisions made by DFO. Participants are generally very critical of the flawed management approaches developed through a politically based decision-making process. One must recognize, however, that those who are the most critical of the process are often the strongest lobbyists.
4. The snow crab management process needs to be more inclusive. Harvesters and other interested parties want to have a role in fisheries management. Participants feel that the decisions are made far away in Ottawa and are based on unknown recommendations from DFO officials. Generally, participants and interested parties want a more relevant and purposeful role in decision-making.

5.5 The Call for Change

The thrust for change is apparent within DFO and among industry participants. All parties appear to have come to the conclusion that it is time for the stakeholders to take a more active and meaningful role in the management of the fishery. **The Council has concluded that it is time to change the way the Atlantic snow crab fisheries are managed.**

5.5.1 Fisheries and Oceans Policy

The DFO appears committed to the concept of shared-stewardship. Its recently released March, 2004 document "A Policy Framework for the Management of Fisheries on Canada's Atlantic Coast" (the "Policy Framework") identifies the concept as one of its four major objectives. The Policy Framework states:

> *"Participants will be effectively involved in fisheries management decision-making processes at appropriate levels; they will contribute specialized knowledge and experience, and share in accountability for outcomes."*

Two of the nine principles that flow from the objectives refer to more inclusive decision-making that will primarily involve resource users and the need to make operational decisions locally where possible. The FRCC commends DFO for adopting the Policy Framework and moving toward its implementation. The Council also notes the Minister's commitment to moving forward. In a March 10, 2005 press release on creating stability in the fishery, the Minister stated:

> *"I want to entrench the principle of co-management throughout Canada's fisheries and develop a range of measures and incentives to increase industry's participation throughout the decision-making process."*

5.5.2 Harvesters' position

Following widespread public consultations and a three-day workshop, the FRCC has concluded the following from comments made by harvesters and others:

- Most participants are generally dissatisfied with the current top-down management of the fishery exercised by DFO;
- There is a perception that political considerations sometimes override conservation concerns and stakeholders want to see that changed;
- Decision-making should be made in the regions within Atlantic-wide policy guidelines for consistency among management areas as appropriate;
- Harvesters express a willingness to share decision-making on many management measures and some groups are willing to establish formal agreements outlining the roles, responsibilities and accountabilities of the parties to a co-management arrangement; and
- Some inshore groups appear satisfied with the goodwill model outlined above and do not want to pursue formal co-management arrangements.

The desire on the part of snow crab stakeholders for more meaningful input into the management of the snow crab fishery cannot be overstated.

5.5.3 Benefits

The readiness of DFO to develop genuine partnerships coupled with the industry's desire to take a hands-on role in fisheries management creates an ideal climate for the fundamental change many feel is required. New management structures must be developed which are efficient, effective and affordable.

The FRCC's interest in shared-stewardship is rooted in its belief that if stakeholders are permitted a genuine and purposeful role in the management of the fishery, they will accept more responsibility and accountability for its long-term sustainability. DFO's Policy Framework holds a similar view:

> *"Conservation is more easily attained if resource users, coastal communities and other participants take greater responsibility for stewardship of the resource. Promoting a conservation ethic is one of the most important preconditions for sustainable management of fisheries. The greatest hope for the Atlantic fisheries is that the push for sustainable use will increasingly come from wharves, boats and local meeting rooms, with the department working hand in hand with all participants to achieve shared objectives."*

One of the important objectives of a shared-stewardship approach is the development of a better relationship among the parties, including harvesters, fisheries managers, scientists, environmental and community groups. A collaborative approach will foster better cooperation and more commitment to goals. In addition, improved efficiency and more timely management decisions should result. The delegation of authority within DFO to local and regional levels should enhance the timeliness of important operational decisions. The result should be the evolution of a sound conservation ethic leading to an economically and biologically sustainable snow crab fishery managed through structured institutions for the benefits of its participants and their communities.

5.6 Requirement for Change

5.6.1 The Act

The *Act* is often cited as an impediment to shared-stewardship because it apparently limits the Minister's ability to share decision-making authority with participants. While legislative change may indeed be the ultimate solution, the Council believes that it is possible to move forward within the current structure. After all, the industry has had certainty of allocations in Enterprise Allocation (EA) and ITQ systems for some twenty years without disruption. The more recent informal snow crab arrangements in some inshore areas of Newfoundland are another example of stability. It appears clear that with a will to proceed and good faith among the parties, shared-stewardship that grants a meaningful role for stakeholders in the management of the fishery can be achieved.

5.6.2 Challenges

In the view of Council four challenges must be addressed over the short-term in order to proceed with shared-stewardship in the snow crab fishery:

1. First and foremost, the issue of access and allocation must be resolved. As noted above, without certainty of access to the resource for a reasonable period of time, stakeholder responsibility and accountability will remain difficult to achieve. Until the issue is settled, harvesters will devote most of their energy to battling over access and allocation and will not progress to the next step of constructive management of the fishery. The Policy Framework in reference to access and allocation issue states:

   "Ongoing uncertainty about access to fisheries resources and allocation of harvesting opportunities undermines the department's efforts to develop conservation incentives. If resource users do not have a reasonable degree of certainty that they will share in future returns arising from their conservation efforts, they will have limited incentive to support conservation."

   The FRCC believes that there is a direct link between stewardship, conservation and certainty of access. The more secure the access, the more responsibility the participants will demonstrate toward resource conservation. While some feel that this is best accomplished by the use of individual property rights systems such as EAs or ITQs, the access need not necessarily be in that form. No single form of rights based fishing is appropriate for all situations. Granting access to groups or individuals can in the right circumstances be sufficient to instil the necessary conservation ethic required to properly manage the fishery. The motivation is self-interest and without this issue being addressed, it will be difficult to pursue more meaningful roles for stakeholders. There must be certainty and predictability of access. It should be possible to develop formulae that indicate each participant's share and how it will fluctuate as the TACs for snow crab change.

2. Industry partners wishing to assume a greater role in decision-making must understand that they will be accountable for their decisions. Harvesters must develop mechanisms to resolve their differences among themselves without deferring to DFO in times of conflict.

3. There must be a willingness on the part of DFO to transfer authority to the industry, something it has been reluctant to do in any substantial way. A culture of paternalism has led to a serious mistrust between some industry groups and DFO. These groups believe that DFO will not transform its management style to a structure based on inclusiveness, good faith and transparency. It is therefore, essential that DFO be prepared to recognize industry as a "partner" in the management of the fishery. Without such recognition progress will only be hindered.

4. The fourth issue is that of industry representation. Any approach involving active participation by harvesters in the management process must ensure proper representation. Suitably structured entities must be formed where they do not already exist to ensure due participation of the harvesters they purport to represent. DFO needs assurance that the entity with which it is dealing is properly constituted and accountable to its members. Some capacity building may be required here on the part of DFO to facilitate industry engagement. Industry groups must be encouraged to focus on common goals and come together in meaningful constituencies in order to move forward with purpose.

In any partnership, the roles of the parties must be clearly outlined and understood. It is obvious that in the current context DFO bears the ultimate responsibility for the conservation and protection of the fisheries resource and its habitat. It also bears the primary role to ensure that the scientific knowledge base is adequate for that purpose. Industry on the other hand is more focused on determining when, where and how to fish such that its operations and practices are consistent with ensuring sustainability. In the current relationship, DFO controls all aspects of the fishery. Finding the right balance will be a challenge but it is clear that fundamental structural and attitudinal change is required in order to move forward.

5.7 The Way Forward

5.7.1 Shared-stewardship

Often distinctions are made between partnering, co-management and shared-stewardship. For the purposes of the FRCC's discussion, the terms are used interchangeably. In the end the concept contemplates some form of participatory decision-making accompanied by shared responsibility and accountability for the management of fisheries. A number of common characteristics are present:

- A collaboration between parties with shared and/or compatible objectives;
- A legally binding agreement for a specified period;
- An outline of terms and conditions for management;
- Shared authority and responsibility is specified;
- A commitment to an investment of time and resources by both parties;
- A sharing of risks and benefits; and
- A dispute resolution mechanism.

5.7.2 Elements of an effective partnering arrangement

Most, if not all, current co-management or partnering agreements lack one essential element – they do not grant meaningful authority, responsibility and accountability to the industry. The development of an effective co-management/partnering framework in the snow crab fishery is an opportunity for DFO to put the principles of participatory management as outlined in the Policy Framework into practice.

Any partnering/co-management structure must cover several critical elements:

Access

A settlement on access and allocation to the fishery for the participants for a specified period, including at the very least multi-year TACs (with annual reviews on conservation grounds), an agreed sharing formula among the participants as well as a mechanism to deal predictably with any potential increase or decrease of licences due to resource abundance.

Management Authority

A legally structured management entity should be created with minimum provisions including bylaws containing rules of membership, voting, meetings, etc.

Functions and Powers

The authority of the management body must be clearly set out in collaboration with DFO and should include such things as the development of multi-year management plans; the review of scientific advice on the state of the resource; the establishment of and modifications to the TAC in collaboration with DFO; the development/modification of operating guidelines for sharing participation in the design/conduct of scientific research and observer programs; input into conservation measures; and the development of a penalty structure for infractions to the management plan.

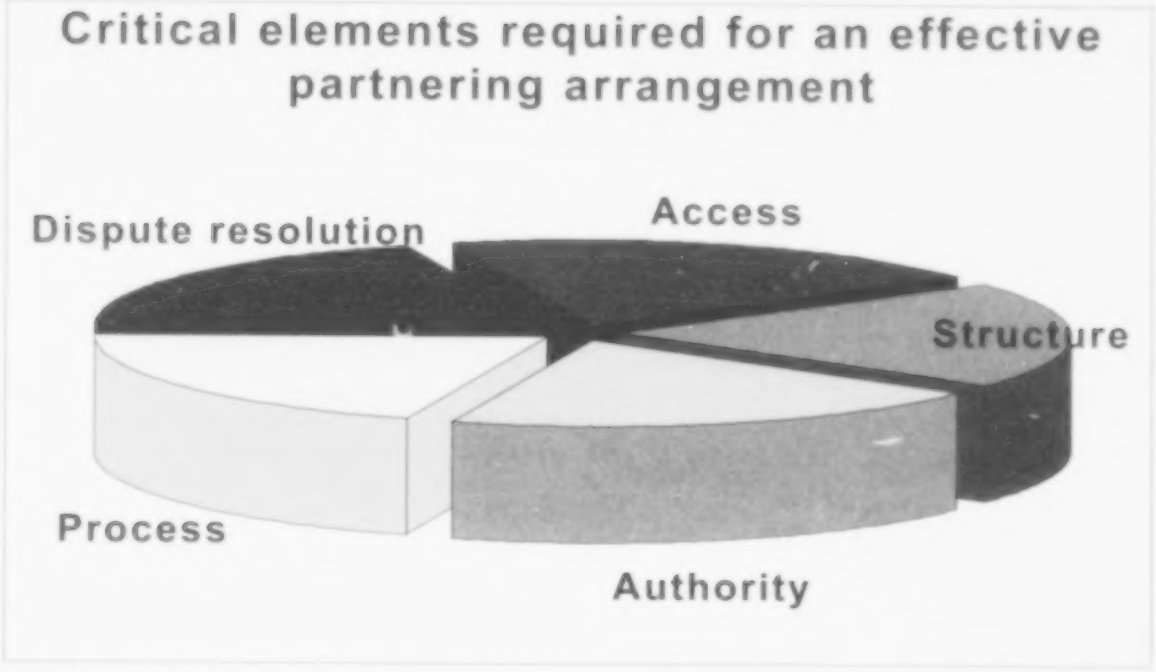


Figure 7: Critical elements required for an effective partnering arrangement

PROCESS

The challenge is to develop a process that gives the management body decision-making authority in as many areas as possible and effective authority to make recommendations in other areas while at the same time recognizing the Minister's ultimate legislative responsibility for the management of fisheries.

DISPUTE SETTLEMENT

The agreement should include the provision of a third-party arbitration process for the resolution of disputes in order to avoid lengthy and costly litigation.

There are management models available for consideration. The Area 19 snow crab co-management agreement seems to work well. The features of the arrangement are outlined in Appendix VI. Another model is that employed by the Nunavut Wildlife Management Board for the management of fisheries resources within its jurisdiction. The essentials of that structure are described in Appendix VII.

5.8 FUNDAMENTAL CHANGE

As noted above, there seems to be a desire for change in the fisheries management process by all parties, notably with respect to more open and transparent decision-making. Several groups also lamented the lack of an appropriate and effective administrative sanctions process to deal with instances of non-compliance in the fishery. The FRCC is of the view that four steps should be taken in order to achieve meaningful change.

1) Create a proper legislative foundation for the management of the fishery

The *Act* is a product of a former time. Incidental amendments have been made over the years however; the basic tenets of the *Act* have remained unchanged since confederation. The *Act* is simply no longer capable of responding to modern and innovative fisheries management approaches.

The Council has concluded that the time has come for a serious overhaul of the *Act* with the objective of creating a proper legislative base for the 21st century, notably in the areas of access and allocation, decision-making, collaboration with industry stakeholders and a well-

grounded administrative sanctions process. The Council understands that DFO is currently studying changes to the *Act* and urges that it proceed without delay.

The Minister also commented on the *Act* in a press release of March 10, 2005 that stated:

> *"I am serious about change," said Minister Regan. "That could mean regulatory change, or even amendments to the Fisheries Act, to give us the tools we need to formalize sharing arrangements, once and for all. This longer-term stabilization reinforces my commitment to moving forward with a progressive, coherent and modernized fisheries management system."*

The FRCC recommends that the *Fisheries Act* undergo a total review in order that it responds to the needs of the modern day fishery, including the provision of open, transparent third-party, rules-based mechanisms for access and allocation, better enforcement tools such as administrative sanctions as well as to provide a foundation for shared stewardship.

2) Create an open, transparent decision-making process for access and allocation issues

It is difficult for an elected official to make decisions on fisheries access and allocation issues on other than a political basis. One need only examine the issuance of the large numbers of snow crab licences over the past number of years. The Council has no quarrel that new access was warranted considering the significant increase in abundance of snow crab stocks, but the complete absence of any analysis or attempt to balance that new access with the available resource is striking. Practically overnight, a huge overcapacity problem was created, a situation that will be difficult to manage as the snow crab resource declines.

Equally, it is difficult to expect that industry members can be placed in a position to participate in access and allocation decisions. Clearly, the conflict of interest industry participants would have, make such a suggestion untenable.

The Council feels that the solution is the establishment of a permanent independent access and allocation board or panel structure with published procedural rules and guidelines. The board or panel would operate at arm's length and be comprised of people completely independent of DFO and industry. Such a concept is not new to Canada and exists in many regulated industries. Board or panel members should be appointed for their skills and merit. The board would be assigned a clear mandate and operate in an open and transparent manner. Policy guidelines could be provided to guide decision-making and participants would be required to follow an established process and advance focused analytical presentations. The board would conduct public hearings, receive submissions and make public recommendations to the Minister.

Under a board structure, the Minister would retain the final decision-making authority but the process would define the context for decision-making and would create an open public process without political affinities. An independent board may not stop attempts to circumvent the process, however, it will make such attempts much more difficult. It would assist transition to the arms-length, third party legislative mechanisms noted in the previous recommendation.

The FRCC recommends that an independent, third party, apolitical structure be established to hold public hearings and make public recommendations on access and allocation issues.

3) Move quickly to shared-stewardship arrangements

It is time to accelerate the process on shared-stewardship through the development of a framework for co-management containing guidelines for participation by the stakeholders. Recommendations flowing from the process should be made public and would go directly to the decision-maker without additional analysis or commentary. The concept should be offered to all groups that meet the requirements of the framework.

The FRCC recommends that a framework for co-management including provisions for participatory decision-making by stakeholders, an open-transparent process, and dispute settlement mechanisms be developed and published.

4) Open up the advisory process

The issue of inclusiveness must be addressed. During consultations, harvesters were clear in their advice on the participation of other parties in the consultative process - they do not wish to see non-governmental organizations (NGO's), municipalities or other non-direct stakeholders involved in the process. Their view is that the process is complex enough with the existing participants and fear that additional participants with

other objectives would grind the process to a slow pace and in the end it would be non-productive.

While there are clearly challenges in integrating other interested parties to the process, the Council is of the view that transparency cannot be achieved unless all interested parties are included in the process. Canadians want to be represented in the process. The fisheries management landscape is changing and it is time for a more inclusive approach. If a new management structure is not inclusive then there will naturally be other constituents who will remain in conflict with the approach being taken by those selected to participate in decision-making. The very nature of the ocean environment and its resources being excluded from open public participation is not realistic in the context of shared-stewardship.

The Policy Framework and the FAO Code of Conduct for Responsible Fisheries both explicitly state the need and importance of involving all interested parties.

Policy Framework:

- "Governments, resource users and others with an interest in the fisheries share responsibility for the sustainable use and economic viability of fisheries.
- Fisheries management decision-making processes must be, and must be seen to be, fair, transparent and subject to clear and consistent rules and procedures.
- Fisheries management decision-making processes will be more inclusive so that resource users and others will have appropriate opportunities to participate."

FAO Code of Conduct (Article 6:13):

> *"6.13 States should, to the extent permitted by national laws and regulations, ensure that decision-making processes are transparent and achieve timely solutions to urgent matters. States, in accordance with appropriate procedures, should facilitate consultation and the effective participation of industry, fishworkers, environmental and other interested organizations in decision-making with respect to the development of laws and policies related to fisheries management, development, international lending and aid."*

Given the critical importance that fisheries have for numerous coastal communities of Atlantic Canada and Québec, it is only natural that members of those communities participate in the strategic decisions affecting one of their main sources of wealth.

As a practical matter, it may be appropriate to create a hierarchy of issues so that a wider constituency participates in the overarching issues such as harvesting strategies, conservation measures and ecosystem concerns on a three to five year schedule. Such participation could occur during the advisory committee process. The operational issues, those that are short-term, can be subject to a dialogue between harvesters and DFO within the framework of a collaborative approach.

The FRCC recommends that an advisory process for snow crab include the participation of a wider variety of interested parties such as NGO's, environmental and community interests.

5.9 Summary

The implementation of the above recommendations will address the Policy Framework's commitment to processes that are "fair, transparent and subject to clear and consistent rules and procedures". It is clearly time for a new approach.

There is no 'ideal' management approach for the many and varied snow crab fisheries throughout the Atlantic region. The snow crab fishery is complex and geographically diverse and, while, there are common elements to all harvesting plans, management is unevenly applied throughout the Atlantic area. Nevertheless, harvesters and the FRCC have concluded that change to the management model is necessary and new management approaches can be effectively used in many areas of the snow crab industry.

One thing is clear – it is time to develop a system that grants an effective role in the decision-making process to the snow crab industry in the current legislative setting. The snow crab fishery is well suited to cooperative management – single species, one fishing strategy, common conservation measures, generally lucrative, individual quota-based, single gear type, etc. Past tensions are easing and could be resolved under a well-structured arrangement. Cooperative mechanisms can be developed with some creative thinking. It is time to allow the industry the necessary scope to participate in a meaningful way in the effective management of the fishery. The only requirements are the commitment to the concept and the will to get it done by all the parties.

6 Conclusion

In this report, the FRCC provided a comprehensive series of recommendations to achieve long-term sustainable snow crab fisheries throughout Canada's Atlantic coastal regions. The Council observes the need for immediate action on a number of pressing issues plaguing the conservation of the resource and the industry. Despite the knowledge acquired during the years of hardship experienced during the resource downturn in the 1980s, the Council was surprised that very little of this experience has been transferred throughout the industry and among the many new participants that have entered the fishery since the early 1990s.

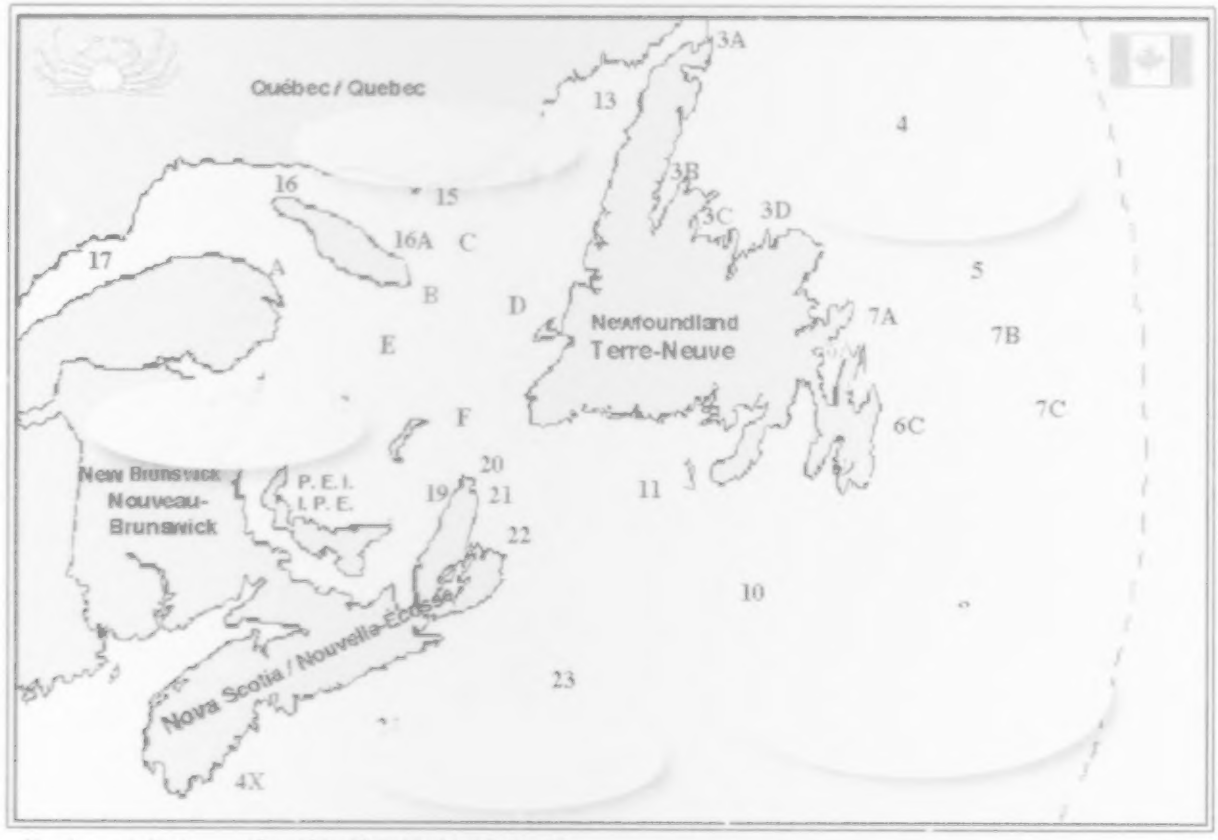
The increase in fishing effort and the lack of a modern management structure are seen as further challenges that industry and DFO will need to overcome to ensure, not only a sustainable fishery, but long-term conservation of the resource. The Council is not suggesting that it is too late to institute a sustainable fishing industry in Atlantic Canada and Québec, however, it feels that immediate measures are required to reverse the trend experienced in certain areas. Planning for the implementation of a more conservation oriented harvest and a clear partnership with industry should also be a focus of discussion and efforts over the coming months.

Finally, the FRCC would caution against the use and interpretation of certain recommendations outside the context of the report. The Council considers the conclusions and observations as important as the recommendations that it has made. As the Council has repeated at all of its public consultations and meetings with stakeholders, "one shoe does not fit all" and we believe that each region can benefit from elements of the strategic framework report. More importantly, the Council believes that harvesters from all regions can benefit from what others have experienced or implemented in their area.

Appendices

Appendix I: Landings by major area

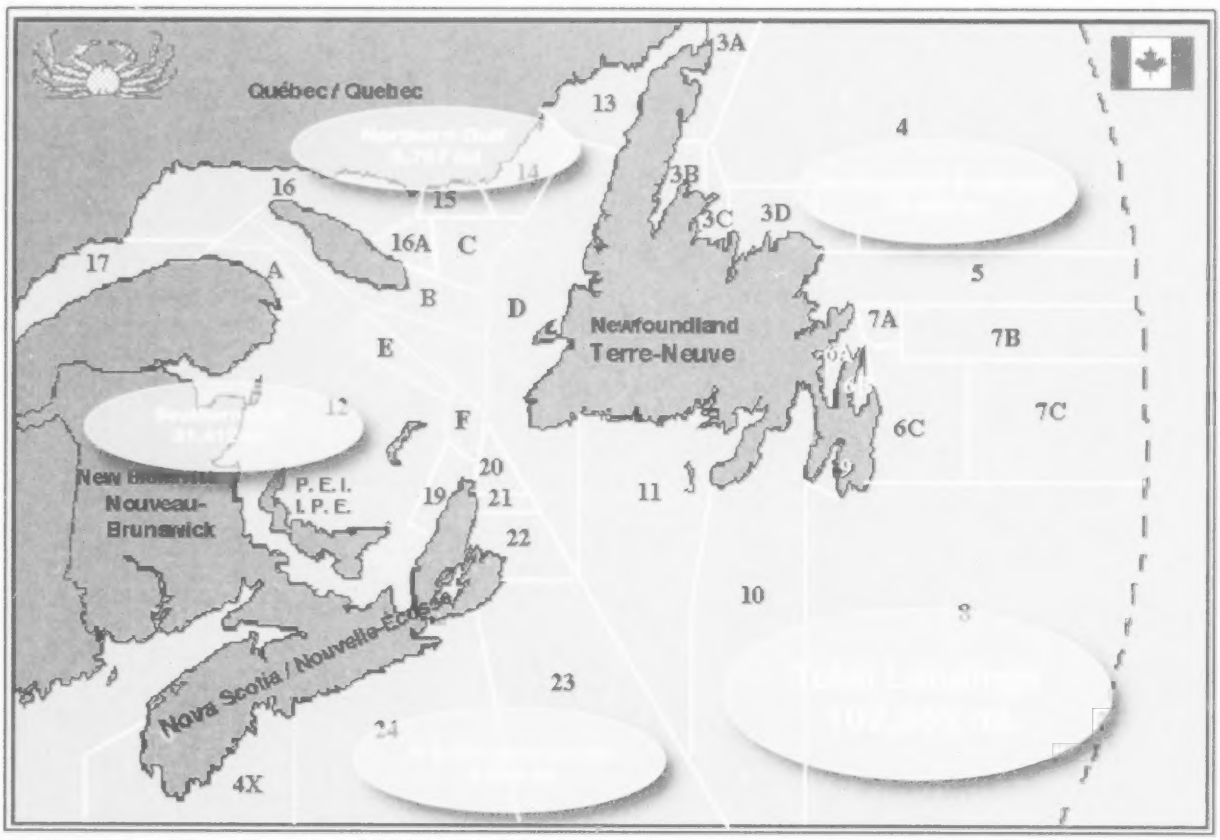
Atlantic Snow Crab Landings 2004



Southern Gulf: Areas 12A, 12B, 12C, 13, 14, 15, 16, 17
Southern Gulf: Areas 12, 12E, 12F, 19
East and SW Nova Scotia: Areas 20, 21, 22, 23, 24
Newfoundland: Areas 3A, 3B, 3C, 3D, 4, 5, 6A, 6B, 6C, 7A, 7B, 8, 9, 10, 11

APPENDIX I: LANDINGS BY MAJOR AREA

ATLANTIC SNOW CRAB LANDINGS 2004



Northern Gulf: Areas 12A, 12B, 12C, 13, 14, 15, 16, 17
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Appendix II: Sex ratios

How harvest rates affect sex ratios and how the effects may impact reproduction, density dependent maturity and genetic change.

During mating, the typical male snow crab behaviour is to hold a virgin female crab captive until she moults and can be mated. Their aggressive mating behaviour gives a clear advantage to the largest males at times when male numbers exceed females. Females mature at a much smaller average size than males and therefore they mature several years earlier than do males. Hence, virgin female crabs mate with male crabs that are several years older.

Snow crab recruitment is cyclical. When a strong recruitment pulse of females matures, the males from the same cohort will not be ready for mating, and the only available males for mating will be those from earlier, possibly smaller, cohorts. At low harvests rates on male crab this may not matter; males from a number of cohorts can accumulate. When harvest rates are higher, the only large mature males will be those just maturing from the smaller cohorts. At such times there may be a substantial deficit of large mature males.

The figure below illustrates the problem. It is based upon reasonable assumptions about snow crab population dynamics. It indicates that if snow crab has cyclic recruitment then:

- with no fishing, large male crabs will accumulate over a number of years. Male numbers then often exceed first time spawning female numbers and are seldom much less than half;
- there are generally enough males if the harvest rate on males is 20 %, however, at times there may only be one large male to four virgin females; and
- by contrast if the harvest rate of males reaches 80 % then the number of large mature males tends to drop close to zero just when females are most abundant.

At the higher harvest rates, virgin females would at times have to mate either with a runt (a mature male crab smaller than 95mm) or with an adolescent (a male in its penultimate moult stage). At this stage males are sexually mature but have not yet developed large fighting claws. There could be a number of possible

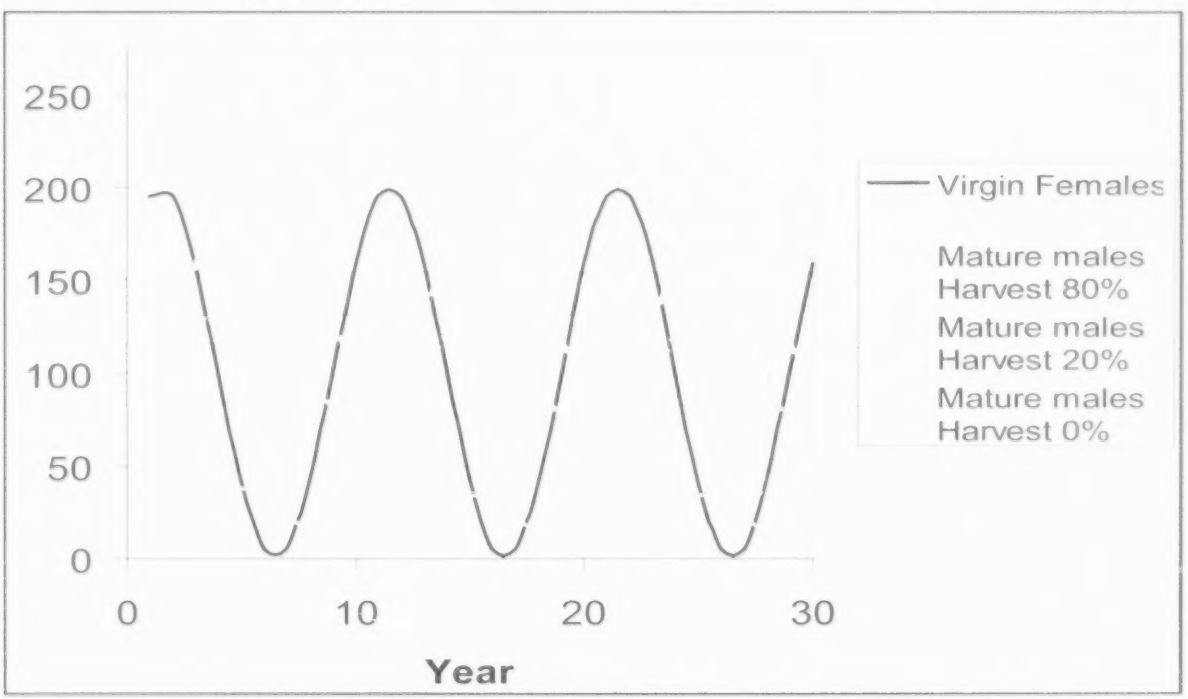


Figure 8: Illustration of the numbers of females and mature males at different harvest rates.

outcomes:

- at worst significant numbers of females might be unfertilized and thus future recruitment may be jeopardized;
- runts would be more available to mate then the larger males and in the longer-term genetic drift may lead to populations with larger proportions of runts; and
- pre terminal moult males are able to mate successfully this may give them a signal to moult at a smaller size.

Any of these outcomes would be highly undesirable for a fishery that harvests only large males. Therefore, maintaining reasonable sex ratios appears to be a logical precaution to consider in regard to managing the resource in a sustainable manner.

Appendix III: Soft-shell crab

Why harvesting soft-shelled crab reduces yield from snow crab resource

The traditional view to exploiting the snow crab resource is that it is best to harvest mature male (hard-shell) snow crab at a high rate. Snow crab no longer grow after their terminal moult therefore, it is better they are caught before they die naturally. This exploitation strategy may be flawed, if the high harvest rates cause significant mortality to soft-shell crab that are captured and discarded during the harvesting process. For example, if the harvest caused all the moulting or soft-shelled crab to be killed then there would be no new mature crabs the following season. While it is an extreme assumption to expect that all soft-shelled crab would be caught or would die, it is reasonable to assume that a significant percentage of the soft-shell crab harvested do indeed die. In fact scientists and harvesters both agree that the large majority of soft-shelled snow crab harvested do not survive. The illustration below shows the essence of the problem.

Some simplified assumptions can help illustrate the affects of harvesting soft-shelled snow crab. Assume the following:

- no natural deaths of soft-shell snow crab;
- unless caught, hard-shell snow crab all live three years after the final moult and then all die or are of no commercial value;
- some proportion (for example a third) of the harvest rate on hard-shell snow crab acts to kill soft-shelled snow crab; and
- no possible effects that a lack of males might have on breeding success.

Suppose that the harvest rate on hard-shell crab was 60% per year and as assumed above 1/3 of this harvest rate acts to kill soft-shell crab. Following the fate of 100 newly moulted snow crab, we can explore the outcome:

Of the 100 soft-shell crab, 20 would be killed and wasted as soft-shell crab. Note that 1/3 of 60 % = 20%. Thus, 80 crabs survive to become hard-shelled. In their first year 48 (60% of 80) of these are caught. The remaining 32 crabs survive to the second year and then about 19 are caught. Therefore, the remaining 13 crabs survive to the third year and about 8 are caught. The remaining 5 die of old age and are wasted. So in this example the total catch over the three years is 48 (Year 1) + 19 (Year 2) + 8 (Year 3) = 75 crabs in total of the initial 100 snow crabs. Therefore, given the assumptions 25 crabs were wasted, 25% of the total available to the fishery.

Similar calculations can be made for other combinations of harvest rate and the proportion of the harvest that acts to kill soft-shell crab. The table below shows the hard-shell crab that would be caught out of an initial 100 for various combinations of harvest rates and the proportion of the harvest rate that acted to kill soft-shell crab.

Table 2 shows the results of calculations for other combinations of harvest rate and of the proportion of the harvest rate acting to kill soft-shelled snow crab. The highlighted cell (75) corresponds to the example described above. The table illustrates that if the proportion of soft-shell snow crab dying as a proportion of the harvest rate is high at 2/3, then a 40% harvest rate gives the highest yield of the options shown (58 hard-shelled crab caught). If the proportion of soft-shelled crab that is killed were lower at 1/3 then the 60% harvest rate would give the best yield (75 hard-shelled crab caught). However, the yield is not much better than at the 40% harvest rate (68 hard-shelled crab caught). Moreover, it would require almost twice the number of trap days to achieve the higher harvest rate. Since the catches at the two rates is similar it follows that the catch rate would be almost twice as high with the lower harvest rate!

The table also shows that the yield (the catch of hard-

Number of Hard-Shelled Crab Caught of 100

	Proportion of harvest rate acting to kill soft-shelled crab		
Harvest rate	**0**	**1/3**	**2/3**
20%	49	46	42
40%	78	68	58
60%	94	75	57
80%	99	73	47

Table 2: Hard-shelled crab caught

shelled snow crab) is always highest when in the zero column. Therefore, if soft-shelled crab can be avoided, then the catch will be optimal. This indicates why it is preferable to avoid catching soft-shell crab at all and why if they are harvested it is important to handle them carefully to reduce mortality to as low as possible. The requirement is most critical when harvest rates are high.

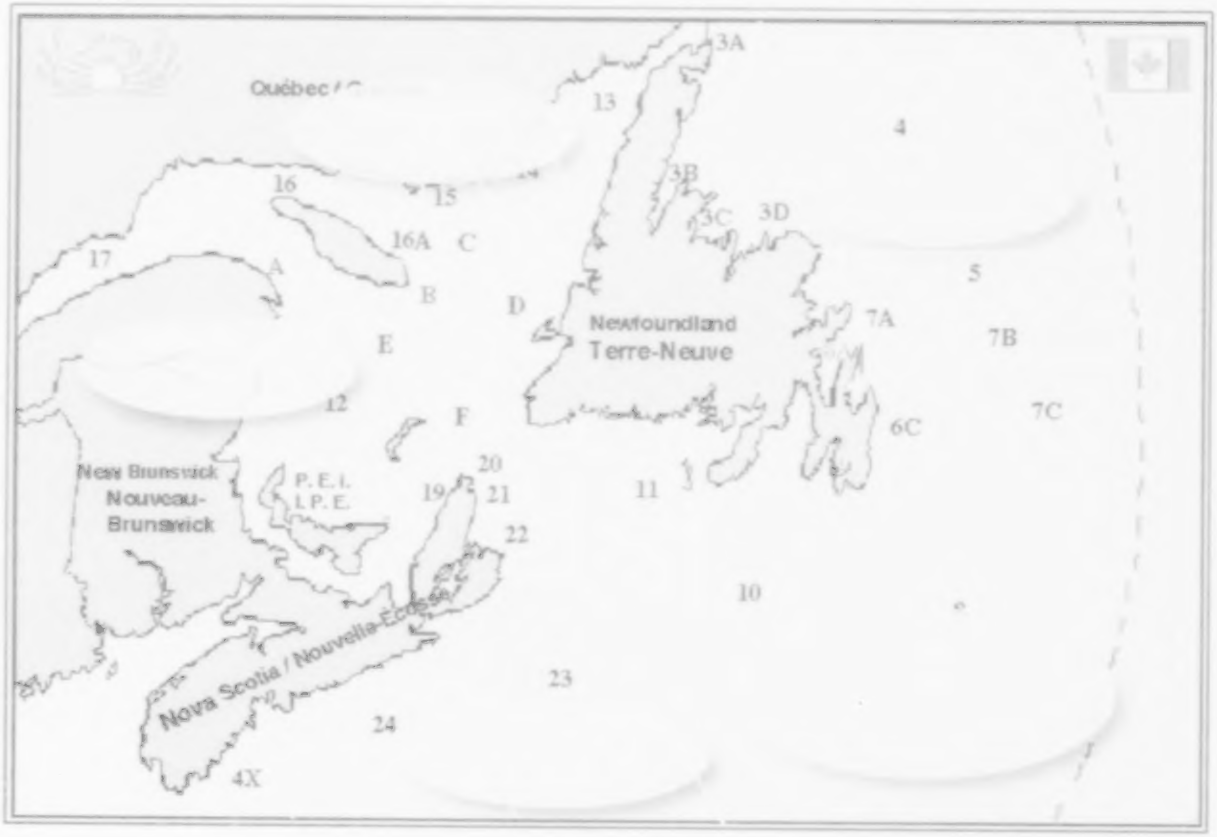
Appendix IV: Soft-shell crab monitoring protocol for 2005

CFA 12, 18, 25, 26

- Quadrants of 10 ' x 10 '
- 30% at-sea coverage
- Mandatory closure when soft-shelled crab reaches 20% in quadrant
- Calculation based on 15 days
- Info from 8 traps and 2 boats
- Visual estimate by observer if trap has 50% or more of soft-shelled crab; where disagreement occurs between the captain and the observer on the amount of soft-shelled crab, the trap will be sampled
- If the amount of soft-shelled crab in a grouping of quadrants remains at 20% or higher for 14 consecutive days, a sector will be defined and closed for the season
- If the average of soft-shelled crab in Area 12, 18, 25, 26 remains at 20% or more for 14 consecutive days, the Area will be closed for the season
- Representatives advised 5 days prior to closure
- Fishers advised 48 hours prior

Appendix V: Number of licences and traps in the snow crab fishery

Traps and Licences - 2004



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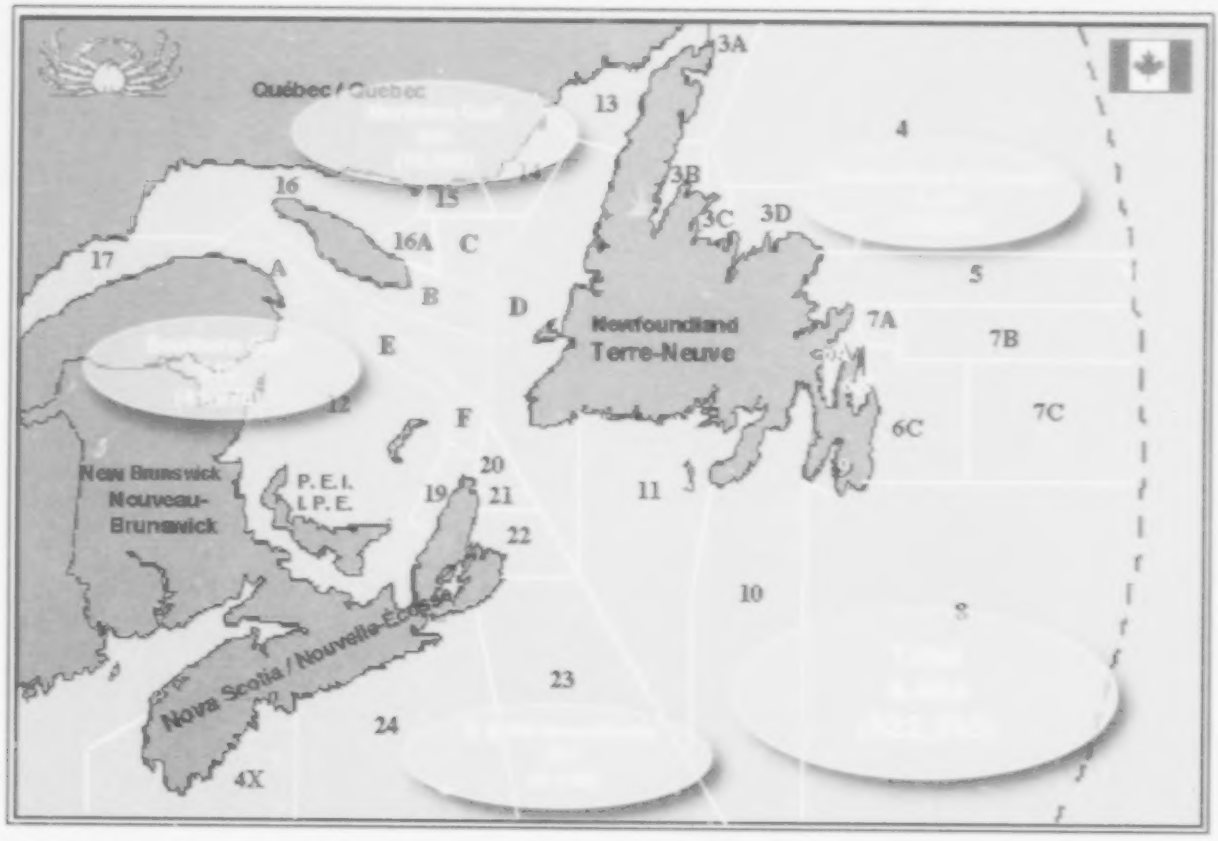
APPENDIX V: NUMBER OF LICENCES AND TRAPS IN THE SNOW CRAB FISHERY

TRAPS AND LICENCES - 2004



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Appendix VI: Area 19 crab co-management agreement model

General

This model is similar to that used in Crab Fishing Area 19 and includes:

- An Integrated Fisheries Management Plan (IFMP) that sets out a series of "Decision Rules" to guide the fishery over a prescribed period of time to achieve a series of mutual objectives. The IFMP contains:
  - An Overview of the fishery including participants, location and time frame for fishing.
  - Stock status and species interactions.
  - Conservation limits.
  - Joint industry / DFO fisheries management objectives.
  - Fisheries management strategies for achieving objectives - TAC setting process; access and allocation rules; fishing season; conservation protocols, etc.
  - Fisheries management controls - quota monitoring; at-sea observers; surveillance.
  - Performance review process.
- A Joint Project Agreement (JPA) which sets out the in-kind and financial responsibilities agreed to by both parties.
- An acknowledgement that the arrangement is subject to the Minister's absolute authority but with a statement of general expectation and intent.

Operational Structure

- A formal "Management Committee" comprised of representatives of the incorporated fishermen's association (representing licence holders) and DFO Managers situated as close to the fishery as possible is agreed.
- Management Committee approves Annual Harvesting Plan that establishes specific management measures consistent with the Decision Rules.
- An annual work plan is developed under the JPA and operationalizes the corresponding in-kind and monetary contributions of each party.

Negotiation Process

Fundamental to the concept is DFO's recognition of the licence holders as the key partners in co-managing the fishery while at the same time ensuring that any co-management negotiation process be transparent and inclusive of a wider community.

- Public notice of DFO's intention to enter into Co-Management negotiations with a particular fleet and invite feedback within a set time-frame.
- Development of a mandate for a DFO Negotiating Team with direction on both process for negotiations and DFO objectives.
- Direct negotiations with the licence holder association (Association) - a duly formed legal entity representing a strong majority (2/3) of the licence holders and also mandated to negotiate.
- Third parties invited to observe upon mutual consent.
- DFO retains option to consult with other relevant stakeholders as required.
- Clear understanding that conservation is not negotiable and that future allocation rules cannot fetter Minister's authority.
- A written set of Points of Agreement (PoA) is the main product of the negotiations.
- These PoA are presented to DFO for preliminary approval then ratified by the Association.
- The PoA is then communicated to the wider stakeholder groups and feedback would be invited within a prescribed timeframe.
- Any concerns are brought back to the negotiating table for resolution.
- The final PoA would be approved by the Minister and the Association membership and form the basis for the IFMP and the JPA.

Appendix VII: Nunavut Wildlife Management Board Model

General

This arrangement arises out of the Nunavut Land Claims Agreement. The agreement establishes an entity called the Nunavut Wildlife Management Board (NWMB). This model has been called a "legislated partnership" whereby the distinct roles, authorities and responsibilities of the parties are set out in legislation. This particular piece of legislation grants specified decision-making authority to the NWMB governed by a process which ensures that the Minister of Fisheries and Oceans also meets his/her responsibilities.

While this model is legislatively based and beyond the scope of this report, it is the process for the approval of fisheries management plans which is interesting and may be useful in developing a process for decision-making in snow crab management.

Access

The agreement recognizes the board as the main regulator of access to wildlife inside the Nunavut Settlement Area.

Functions and Powers

- Conducts research
- Establishes total allowable harvest
- Sets/adjusts basic needs level
- Allocates resources
- Makes recommendations as to allocation of surpluses
- Establishes/modifies/removes non-quota limitations
- Sets trophy fees
- Any other function the NWMB is required to perform by the Agreement

Process

The process gives the management body effective decision-making authority while at the same time recognizes the Minister's ultimate legislative responsibility. This is accomplished by permitting the authority to manage the fishery with a veto power retained by the Minister. Basically, the authority has decision-making power for the entire fishery with ministerial intervention only to effect a valid conservation purpose or to provide for public health or public safety.

It works like this:

- Decisions of the Authority are forwarded to the Minister
- The Minister may,
  - (a) accept the decision
  - (b) reject the decision within a specified period (but only to the extent necessary to effect a valid conservation purpose or to provide for public health and safety)
- Where the Minister accepts the decision or does not reject it within the specified period, he/she must do all that is necessary to implement the decision
- Where the Minister rejects the decision,
  - (a) he/she must do so within a specified period of receipt of the decision
  - (b) the Minister shall give reasons in writing for rejecting the decision
- Where the Minister rejects a decision, the Authority shall reconsider the decision in the light of the written reasons provided by the Minister and make a further decision which it will forward to the Minister as above
- With respect to that further decision, the Minister may,
  - (a) accept the decision
  - (b) reject the decision
  - (c) vary the decision

Such a model could be modified to fit the current legislative restraints in the *Fisheries Act* to give the industry through a management board the authority to manage the fishery as it sees fit but always under the supervision of the DFO. In the first step of the approval process, the department cannot impose a fishery management plan on the industry. It can only reject the plan for explicit reasons which it must outline in writing. In the end, the department could impose a solution but with goodwill and some flexibility, the process could work. The model can be adapted to fit any sharing of authority upon which the parties can agree.

APPENDIX VIII: GLOSSARY

Administrative sanctions: A legislatively-based tribunal process to levy licensing and other penalities for specified fishing offences. The process includes right to hearing before an unbiased tribunal.

Assessment, stock assessment: The process of determining what the status of a fishery stock is in relation to exploitation.

Benthic: characterized by living on the bottom: juvenile crabs become benthic when they settle on the bottom after the planktonic larval phase.

Biodegradable trap materials: Materials that degrade over time such that the trap comes apart and therefore does not ghost fish.

Carapace: A sheet of cuticle extending back from the head to enclose the dorsal and lateral parts of the thorax; the 'shell' of a crab.

Carapace size restrictions: The back, or carapace, of the crab is measured using a preset gauge. Crab size limit is set at 95mm.

Catchability: The efficiency with which animals are captured by a given level of fishing effort. Mathematically, catchability is expressed as the proportion of the stock captured by one unit of fishing effort.

Communal Sharing: A process whereby a fishery is prosecuted by individual enterprises but part or all of the proceeds are shared on a community wide basis, usually in support of infrastructure development. The concept is employed widely by First Nations.

Effective effort: The amount of fishing effort actually applied in a fishery. Effort, fishing effort: The amount of fishing used to obtain the catch (i.e. numbers of traps).

Escape mechanisms: a rigid plastic panel containing an opening which is installed in traps to allow small crabs to escape before being hauled to the surface.

Exploitation rate: The percentage of crabs vulnerable to the fishery which are harvested in a given year. Exploitation rate is another way of expressing fishing mortality.

Input controls: A form of fisheries management in which inputs (fishing effort, fishing gear characteristics, vessel size, etc) are controlled.

Output Controls: A form of fisheries management in which outputs (quotas, landings, etc) are controlled.

Limited entry: A management tool whereby the number of licensed vessels or fishermen in the fishery is restricted or capped.

Crab Fishing Area (CFA): An area within which specific crab management regulations apply.

Marine Protected Area (MPA): A marine geographic area which has been designated for special protection pursuant to the Oceans Act.

Model: A simplified description of phenomena allowing a practical analysis. Mathematical models involve a set of relationships to quantify those phenomena; they are commonly used in assessments of the status of fish stocks.

Moult: a clearly defined series of activities that precede, include and follows shedding of the shell. Among these activities are limb regeneration, decalcification of the old shell, laying down of the new shell, and hardening of the new shell.

Overfishing: The situation when a stock is being exploited beyond its long-term productive capacity.

Planktonic: Drifting in midwater; many marine organisms such as crab have a planktonic larval stage (contrast with benthic).

Regional Assessment Process (RAP): A scientific peer review process of stock assessment data and stock status conclusions, composed primarily of scientists but including industry members.

Recruitment: The process of becoming vulnerable to the fishery. For crab and many other species, recruitment is generally associated with attaining legal size, but this can occur with movement into the fishery area.

Seasons: Times in the year when a crab fishery can occur. Seasons vary from one area to another.

GLOSSARY - CONTINUED

Soft-shell crab: A crab that has just shed its shell and has not yet hardened its new shell.

Spermatheca: Pouch in oviduct of females for reception and retention of spermatozoa.

Stakeholders: All those who have an interest (a stake) in a fishery.

Terminal Moult: Final moulting stage after which time a crab is considered mature.

Threshold: Population abundance at or below which a fishery remains closed.

Trap limits: A limit per vessel of the number of traps that can be set in a Crab Fishing Area.

Appendix IX: List of briefs

L'union des pêcheurs des Maritimes (revised) – January 20, 2005 (2005-010-00018)

Gerard Chidley – December 24, 2004 (2005-010-00002)

NL Fixed Gear Association For Vessels >65' - November 2004 (2004-010-00121)

Larry Pinksen - November 19, 2004 (2004-010-00111)

Greg Roach - November 23, 2004 (2004-010-00116)

Brian Adams - November 8, 2004 (2004-010-00117)

Gord Adams - July 14, 2004 (2004-010-00120)

Pierre Léonard - 18 novembre 2004 (2004-010-00110)

Bruce Chapman - Crab Pots - February 23, 2004 (2004-010-00115)

Recommendations from the Lower North Shore crab Industry - November 5, 2004 (2004-010-00119)

Andy Careen - 3L Under 40 ton Crab Cmt.- October 29, 2004 (2005-010-00026)

Paul Grant – Beothic Fish Processors Limited - October 13, 2004 (2004-010-00104)

Stanley Oliver - LIA October 15, 2004 (2004-010-00106)

Austin Roberts - October 12, 2004 (2004-010-00103)

Dwight Petten - October 19, 2004 (2004-010-00105)

3K Full Time Crab Harvesters - September 29, 2004 (2005-010-00027)

3L Inshore Snow Crab Cooperative Mgmt Panel - Nov. 2003 (2005-010-00029)

Adolphe Kehoe - October 2004 (2004-010-00118)

Mario Déraspe - 6 & 28 Octobre 2004 (2004-010-00101)

Area 19 Snow Crab Fishermen's Association (Chris Kennedy) - October 29, 2004 (2005-010-00028)

Austin Roberts - September 20, 2004 (2004-010-00088)

Martin Daraiche (Governement du Québec) - 22 septembre 2004 (2004-010-00090)

Kevin J. MacAdam (Minister PEI Agriculture, Fisheries, Aquaculture & Forestry) - September 28, 2004 (2004-010-00091)

PEI Fishermen's Association Snow Crab Advisory Board - September 29, 2004 (2004-010-00096)

PEI Snow Crab Fishermen Inc. - October 12, 2004 (2004-010-00097)

Patty King - Fishermen and Scientists Research Society - October 2004 (2004-010-00102)

H.M. Clarke - Association of Seafood Producers - October 4, 2004 (2004-010-00098)

Allan Starkes - Group 6 Crab Committee - October 4, 2004 (2004-010-00092)

Gerard Chidley - October 14, 2004 (2004-010-00100)

Association des pêcheurs de la M.R.C. de Pabok inc. - Octobre 14, 2004 (2004-010-00095)

Gordon MacDonald – Area 23 Snow Crab Fishermen's Association (2005-010-00024)

Brian Adams – Area 19 Snow Crab Fishermen's Association (2005-010-00025)

Association des crabiers acadiens/Association des crabiers gaspésiens/Association des crabiers du nord-est/Association des crabiers de la Baie - January 20, 2005 (2005-010-00030)

Willard Grover – March 31, 2005 (2005-010-00034)

Paul Winger - Snow Crab Selectivity Report - April 8, 2005 (2005-010-00035)

APPENDIX X: FRCC TERMS OF REFERENCE AND MEMBERSHIP

1. INTRODUCTION

The Government of Canada is committed to a more comprehensive approach to the conservation and management of our fisheries resource. This approach demands a better understanding of complex fisheries ecosystems - the interaction of fish with other species, predator-prey relationships, and also changes in the marine environment like ocean currents, water temperatures and salinity.

The Government of Canada is also committed to a more effective role in decision-making for those with practical experience and knowledge in the fishery.

The Minister of Fisheries and Oceans has established the Fisheries Resource Conservation Council (FRCC) as a partnership between government, the scientific community and the direct stakeholders in the fishery. Its mission is to contribute to the management of the Atlantic fisheries on a 'sustainable' basis by ensuring that stock assessments are conducted in a multi-disciplined and integrated fashion and that appropriate methodologies and approaches are employed; by reviewing these assessments together with other relevant information and recommending to the Minister total allowable catches (TACs) and other conservation measures, including some idea of the level of risk and uncertainty associated with these recommendations; and by advising on the appropriate priorities for science.

2. DEFINITION OF CONSERVATION

Fisheries conservation is that aspect of the management of the fisheries resource which ensures that its use is sustainable and which safeguards its ecological processes and genetic diversity for the maintenance of the resource. Fisheries conservation ensures that the fullest sustainable advantage is derived from the resource and that the resource base is maintained.

3. COUNCIL OBJECTIVES

3.1 To help the government achieve its conservation, economic and social objectives for the fishery.The conservation objectives include, but are not restricted to:

3.1.1 rebuilding stocks to their 'optimum' levels and thereafter maintaining them at or near these levels, subject to natural fluctuations, and with 'sufficient' spawning biomass to allow a continuing strong production of young fish; and,

3.1.2 managing the pattern of fishing over the sizes and ages present in fish stocks and catching fish of optimal size.

3.2 To develop a more profound understanding of fish-producing ecosystems including the inter-relationships between species and the effects of changes in the marine environment on stocks.

3.3 To review scientific research, resource assessments and conservation proposals, including, where appropriate, through a process of public hearings.

3.4 To ensure that the operational and economic realities of the fishery, in addition to scientific stock assessments, are taken into account in recommending measures to achieve the conservation objectives.

3.5 To better integrate scientific expertise with the knowledge and experience of all sectors of the industry and thus develop a strong working partnership.

3.6 To provide a mechanism for public and industry advice and review of stock assessment information.

3.7 To make public recommendations to the Minister.

4. Mandate and Scope

4.1 The Fisheries Resource Conservation Council will address these objectives by bringing together industry, DFO science and fisheries management, and external scientific and economic expertise in one body.

4.2 The Council will:

4.2.1 advise the Minister on research and assessment priorities;

4.2.2 review DFO data and advise on methodologies;

4.2.3 consider conservation measures that may be required to protect fish stocks;

4.2.4 review stock assessment information and conservation proposals, including through public hearings, where appropriate; and,

4.2.5 make written public recommendations to the Minister on TACs and other conservation measures.

4.3 The Council may recommend any measures considered necessary and appropriate for conservation purposes such as TACs, closure of areas to fishing during specific periods, approaches to avoid catching sub-optimal sized fish or unwanted species, and restrictions on the characteristics or use of fishing gears.

4.4 The Council's scope includes Canadian fish stocks of the Atlantic and Eastern Arctic Oceans. In the first instance, the Council will address groundfish, and then subsequently take on responsibility for pelagic and shellfish species.

4.5 The Council may also advise the Minister on the position to be taken by Canada with respect to straddling and transboundary stocks under the jurisdiction of international bodies such as the Northwest Atlantic Fisheries Organization (NAFO).

5. Size, Structure and Make-Up

5.1 The Council will consist of not more than 14 members with an appropriate balance between "science" and "industry".

5.2 Members are chosen on merit and standing in the community, and not as representatives of organizations, areas or interests.

5.3 'Science' members, are drawn from government departments, universities or international posts, and are of an appropriate mix of disciplines, including fisheries management and economics.

5.4 'Industry' members are knowledgeable of fishing and the fishing industry and understand the operational and economic impacts of conservation decisions.

5.5 All members of the Council are appointed by the Minister.

5.6 All members, including the Chairperson, are appointed for a three year term; terms can be renewed.

5.7 Members appointed from DFO serve 'ex officio'.

5.8 Members h ve to disclose any interest in the Atlantic or Eastern Arctic fishery and take appropriate measures so as to avoid potential or real conflict of interest situations during the term of appointment.

5.9 The four Atlantic Provinces, Québec and Nunavut may each nominate one delegate to the Council. These delegates have access to the Council's information, and may participate fully in meetings, but will not be asked to officially endorse the formal recommendations to the Minister.

5.10 The Council is supported by a small Secretariat, to be located in Ottawa. The Secretariat will:

5.10.1 provide administrative support for the functioning of the Council;

5.10.2 provide a technical science and fisheries management support;

5.10.3 organize Council meetings;

5.10.4 record decisions of the Council;

5.10.5 undertake a professional communications function for the Council, providing a central point for communications to and from the Council; and

5.10.6 undertake such other matters as from time to time might be appropriate.

5.11 The Chairman may appoint an Executive Committee, consisting of the Chairman, Vice-Chairman, and three other Members.

5.12 In addition, the Chairman may, from time to time, strike an "ad hoc" committee to deal with a specific issue.

6. Activities

6.1 Reviews appropriate DFO science research programs and recommends priorities, objectives and resource requirements.

6.2 Considers scientific information - including biology, and physical and chemical oceanography, taking into account fisheries management, fishing practices, economics and enforcement information.

6.3 Conducts public hearings wherein scientific information is presented and/or proposed conservation measures/options are reviewed and discussed.

6.4 Recommends TACs and other conservation measures.

6.5 Prepares a comprehensive, long-term plan and a work plan for the Council which are reviewed annually at a workshop with international scientists and appropriate industry representatives.

6.6 Ensures an open and effective exchange of information with the fishing industry and contributes to a better public understanding of the conservation and management of Canada's fisheries resource.

FRCC MEMBERSHIP

MEMBERS

Jean Guy d'Entremont, Chairman
Gabe Gregory, Vice-Chair
John Angel
Guy Cormier
Donald Delaney
Dr. Brad de Young
Ken Fowler
Douglas Johnston
Dr. Louis LaPierre
Jean-Jacques Maguire
John Pope

PROVINCIAL DELEGATES

Mario Gaudet, New Brunswick
David MacEwen, Prince Edward Island
Pierre Bédard, Québec
Tom Dooley, Newfoundland and Labrador
Clary Reardon, Nova Scotia
Wayne Lynch, Nunavut (non-participant)

DFO EX-OFFICIO

Gilles Belzile
Ken Jones
Andrew Cooper

FRCC SECRETARIAT

Arthur Willett, Executive Director
Tracey Sheehan
Helena Da Costa
Debra Côté

THE FRCC WISHES TO ACKNOWLEDGE THE SPECIAL CONTRIBUTION OF THE FOLLOWING PEOPLE:

Earl Dawe
Dr. Scott Grant
Dr. Mikio Moriyasu
Bernard Sainte-Marie
Elmer Wade
Dr. Paul Winger

Appendix XI: Acronyms

CPUE:	Catch per unit of effort
DFO:	Department of Fisheries and Oceans
EA:	Enterprise Allocation
FRCC:	Fisheries Resource Conservation Council
IFMP:	Integrated Fisheries Management Plan
ITQ:	Individual Transferable Quotas
JPA:	Joint Project Agreement
MPA:	Marine Protected Area
NAFO:	Northwest Atlantic Fisheries Organization
NGO:	Non Government Organization
NWMB:	Nunavut Wildlife Management Board
PA:	Precautionary Approach
PoA:	Point of Agreement
RAP:	Regional Assessment Process
RV:	Research Vessel
SSR:	Stock Status Report
TAC:	Total Allowable Catch

East Coast Crab Fishing Areas

Canada